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(71)Applicant : HITACHI LTD
(72)Inventor : YAMAMOTO HIROTAKA
NAITO TAKASHI
NAMEKAWA TAKASHI
TAKAHASHI KEN
WATANABE MASAHIRO
TAKEO NORIYUKI

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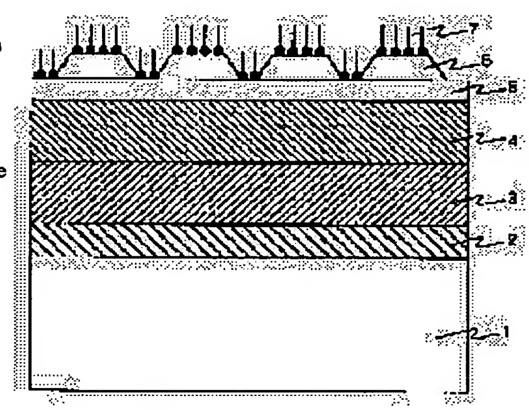
(54) GLASS SUBSTRATE FOR INFORMATION RECORDING DISK

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a glass substrate having enough mechanical strength, chemical stability and light transmitting property by dispersing fine particles containing specified rare earth elements in a specified range of amt. in a glass phase.
SOLUTION: On a glass substrate 1 having 65mm diameter, a 25-nm thick Cr precoating film 2, 50-nm thick Cr base film 3, 50-nm thick CoCr magnetic film 4, and 10nm thick carbon protective film 5 are deposited in this order, and then a texture 6 is formed by etching. Further a lubricant film 7 is applied to constitute a magnetic disk. The glass substrate 1 is prepared by dispersing fine particles comprising Ln203 oxide of one or more rare earth elements selected from Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu. The average grain size of the fine particles is 1 to 100nm. The rare earth elements are included by 0.5 to 20wt.% calculated as oxides to the whole glass.



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CLAIMS

[Claim(s)]
[Claim 1] The glass substrate for information record disks which is a glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of], and is characterized by consisting of glass containing at least one sort of rare earth elements with which said substrate was chosen from the group of Sc, Y, La, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.
[Claim 2] The glass substrate for information record disks which the compression consolidation layer of the surface section of a glass substrate according to claim 1 does not exist, but is characterized by the stress distribution inside a glass substrate being substantially uniform.
[Claim 3] The glass substrate for information record disks characterized by for the very fine particle distributing on said glass according to claim 1, and containing said rare earth elements in this very fine particle.
[Claim 4] Said rare earth elements according to claim 1 are glass substrates for information record disks which are oxide conversion of Ln 2O3 (Ln is rare earth elements), and are characterized by containing 0.5 to 30% of the weight to the whole glass.
[Claim 5] Said rare earth elements according to claim 1 are glass substrates for information record disks which are oxide conversion of Ln 2O3 (Ln is rare earth elements), and are characterized by containing 0.5 to 20% of the weight to the whole glass.
[Claim 6] The glass substrate for information record disks characterized by being at least one or more sorts as which rare earth elements according to claim 1 were chosen from Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.
[Claim 7] The glass substrate for information record disks characterized by the mean diameter of a very fine particle according to claim 3 being 1-100nm.
[Claim 8] The glass substrate for information record disks with which a very fine particle according to claim 3 is characterized by being 1% or more and 40% or less at the rate of the volume to the whole glass.
[Claim 9] Said rare earth elements according to claim 1 are oxide conversion of Ln 2O3 (Ln is rare earth elements). It contains 0.5 to 20% of the weight to the whole glass, and is SiO2 as other components. : 2O3:0 - 17 % of the weight of aluminum is included 40 - 80 % of the weight, B-2O3:0-20 % of the weight, R2O:(R is alkali metal)0-20 % of the weight, and RO(R is alkaline earth metal):0-20% of the weight. And the glass substrate for information record disks characterized by being R2O+RO:10-30 % of the weight.
[Claim 10] The glass substrate for information record disks characterized by the transmission of the visible white light of said glass being 60% or more in claim 1.
[Claim 11] The glass substrate for information record disks which it is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of], and the degrees of hardness of said substrate are 670 or more Hv(s), and the compression consolidation layer of the surface section of 60% or more and a glass substrate does not exist [the permeability of the visible white light], but is characterized by the stress distribution inside a glass substrate being substantially uniform.
[Claim 12] It is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of], and the thickness of said substrate is 0.38mm. Glass substrate for information record disks which it is the following, and the compression consolidation layer of 5nm or less and the surface section of a glass substrate does not exist [the granularity on the front face of a substrate] by Ra, but is characterized by the stress distribution inside a glass substrate being substantially uniform.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to glass substrates for disks, such as a glass substrate for magnetic disks for cover-half magnetic-disk recording apparatus which was applied to the glass substrate for information record disks, especially was excellent in high intensity at chemical stability, thermal stability, and smooth nature, a glass substrate for magneto-optic disks for optical-magnetic disc equipment, an optical disk using the phase transformation of a crystal, and DVD (digital video disc).
[0002]
[Description of the Prior Art] As an information recording apparatus of a mainframe computer or a personal computer, current, a magnetic disk drive, and optical-magnetic disc equipment are in use. Information recording density is increasing these information recording device every year with the formation of small lightweight of equipment, and improvement in the speed of an information R/W rate. For example, in the magnetic disk drive, although 8.8 inches of the diameter of the disk substrate of several years ago were a criterion, in recent years, small magnetic-disk substrates, such as 3.5, 2.5, and 1.8 inch, are developed. Moreover, not only the cutback of the diameter of a disk but disk substrate thickness is 0.63mm. It is thin the following. Therefore, the high intensity substrate is called for also compared with the former. Moreover, the flying height of a head and a medium is becoming small and the smooth nature of the substrate which can control this flying height is called for.
[0003] The aluminum alloy was used for the conventional substrate for magnetic disks. However, that it is easy to deform, since hardness was still more inadequate, the aluminium alloy had the problem that it could not be said that the smooth nature on the front face of a disk after polish is enough. Moreover, when a head contacted a magnetic disk mechanically, there was a problem that a magnetic-recording medium layer tends to exfoliate. Therefore, there is little deformation and development of a large glass substrate of a mechanical strength with good and smooth nature is furthered. Since this glass substrate can be used also as a substrate the magneto-optic disk with which translucency is required of the substrate itself, and for optical disks, it is named generically below the glass substrate for information record disks.
[0004] When current and the above-mentioned glass substrate for information record disks permute the alkali element on the front face of a substrate by other alkali elements, the chemically strengthened glass which raised the mechanical strength, and the glass ceramics which deposited the detailed crystalline substance particle in amorphous glass are developed. However, in chemically strengthened glass, since an alkali permutation layer existed in a front face, at the time of substrate washing, moved to the front face at the time of the heating process at the time of alkali ion being magnetic film membrane formation, and it was eluted, the magnetic film was eaten away, and there was concern which degrades membranous bond strength. For this reason, in JP,7-223845,A, the chemically strengthened glass which was excellent in chemical durability by performing a chemical treatment further after the chemical strengthening has been obtained.
[0005] On the other hand, in glass ceramics, the irregularity after surface polish was not able to say that it was large and smooth nature was enough from the difference in the abrasiveness of the microcrystal particle and amorphous glass to produce. Therefore, it was difficult to deal with lowering of the flying height of a head. In JP,7-300340,A, smooth nature is raised by making a crystal grain child's particle size detailed with 5-100nm.
[0006]
[Problem(s) to be Solved by the Invention] However, there is a problem that it is still difficult to make the property of the substrate after the chemical strengthening in chemical-strengthening down stream processing and a polish process into homogeneity, also with the chemical-strengthening technique of JP,7-223845,A. Furthermore, since the problem on which alkali ion eats a magnetic film away is not solved thoroughly, it is necessary to prepare the interlayer which prevents diffusion of alkali ion between a magnetic film and a glass substrate. Moreover, in order that a substrate may color it opalescence with the glass-ceramics technique of JP,7-300340,A, translucency is low, and application to the substrate for information record media using light is difficult. Moreover, since a highly precise crystallization process is required, there is a problem that it is difficult to make the property of a substrate into homogeneity.
[0007] moreover, the above — since after-treatment processes, such as chemical-strengthening down stream processing and a crystallization process, are required even when which approach is used, low-cost-izing is difficult.
[0008] The object of this invention is to offer the glass substrate for information record disks which has sufficient mechanical strength, chemical stability, and light transmission nature, and can be manufactured in a short-time process.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned object, according to invention of the 1st of this invention, it is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of], and the glass substrate for information record disks characterized by said substrate consisting of glass containing rare earth elements is offered.
[0010] The magnetic medium layer prepared directly on the surface of a substrate, or indirectly [the layer for recording the above-mentioned information], the layer of the matter which causes a phase transformation by the exposure of light. Or if it is layers which information is recorded and can read the information, such as a layer of the matter which is recording information by preparing matter or a mechanical level difference etc. from which the reflection factor of light differs, this invention is applicable no matter it may be what thing. It is preparing between the layer for recording information for an interlayer (precoat film) etc. as preparing the layer for recording the above-mentioned information in a front face indirectly, and a glass substrate. For example,

improvement in bond strength can be aimed at, or this invention is applicable even if it is a configuration for adding the object of controlling a chemical reaction.
[0011] I hear that both sides of a disk disk side or one side is sufficient as surface [at least / a part of], and a case as the layer for recording information only on a periphery and inner circumference side also in respect of the same further is prepared is sufficient as it, and it is.
[0012] The glass substrate for information record disks which has sufficient mechanical strength, chemical stability, and light transmission nature, and can be manufactured in a short-time process by the above-mentioned configuration can be offered.
[0013] In the 1st invention, it is desirable that the very fine particle is distributing on said glass, and said rare earth elements are contained in this very fine particle.
[0014] There is an upper limit (solid-solution limit) in the amount of the rare earth elements which can melt during the glass organization which has the network structure, and if the rare earth elements of the amount exceeding an upper limit are added, it deposits in a glass host phase as a crystal phase or an amorphous phase. The particle which consists of such a crystal phase or an amorphous phase is called the very fine particle. Also when distribution of rare earth elements is an ununiformity, and a very fine particle deposits exceeding a solid-solution limit selectively, for a certain reason, the content of rare earth elements does not necessarily need to be over the solid-solution limit of host phase glass. As for rare earth elements, it is desirable to exist in both of a very fine particle the inside of a glass host phase. Moreover, as for a very fine particle, it is desirable that it is a crystalline substance. If whether it is a crystalline substance observes a lattice image for example, with a transmission electron microscope photograph, the part of a crystalline substance can be easily judged from plaid not being observed into the part of glassiness (amorphous) to plaid being observed.
[0015] In order to carry out the operation to which a particle controls deformation of a glass host phase and destruction for stress also in the carrier beam case when the very fine particle is distributing in a glass host phase, the reinforcement of glass improves more. In this case, the particle currently distributed has [to distribute to homogeneity] the detailed and higher improvement effectiveness in on the strength.
[0016] Moreover, in the 1st invention, said rare earth elements are oxide conversion of Ln 2O3 (Ln is rare earth elements), and it is desirable to contain 0.5 to 30% of the weight to the whole glass. Furthermore, it is desirable to make rare earth elements into 0.5 - 20 % of the weight. The content of rare earth elements is 0.5. The improvement effectiveness of a mechanical strength is small at under weight %. It is difficult for the raw material powder of a rare-earth-elements oxide to remain at the time of the glass dissolution, if it exceeds 30 % of the weight, and to obtain uniform glass. Moreover, if ******** of rare earth elements is exceede the particle size of a very fine particle will become large, and the surface roughness of a substrate will become large.
[0017] The flying height of the magnetic head is more small, and it is desirable to carry out the content of rare earth elements to 20 or less % of the weight to the magnetic disk drive of high recording density.
[0018] In the 1st invention, it is desirable that they are at least one or more sorts as which rare earth elements were chosen from Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu. Since the ionic radius of rare earth elements is large, they tend to deposit in a glass host phase as a very fine particle. Also in rare earth elements, the above-mentioned element is the easiest to deposit a very fine particle in homogeneity in a glass host phase, and its improvement effectiveness in on the strength is high.
[0019] As for the mean particle diameter of a very fine particle, it is desirable that it is 1-100nm.
[0020] The rate of the volume of the grain child to whom mean particle diameter exceeds 100nm increases, and the surface roughness of a substrate becomes large. The flying height of the magnetic head is more small, and it is desirable to set mean particle diameter of rare earth elements to 100nm or less to the magnetic disk drive of high recording density. Moreover, when mean particle diameter is 1nm or less, the strong improvement effectiveness is small.
[0021] It is desirable that the above-mentioned very fine particle is 40% or less at the rate of the volume to the whole glass.
[0022] It is not desirable as the surface roughness of a substrate becomes large when the rate of the volume of a deposit particle exceeds 40%, and stated above.
[0023] In the 1st invention, said rare earth elements are oxide conversion of Ln 2O3 (Ln is rare earth elements). Contain 0.5 to 20% of the weight to the whole glass, and 2O3:0 - 10 % of the weight of aluminum is included as other components 2:40 - 80 % of the weight of SiO(s), B-2O3:0-20 % of the weight, R2O:(R is alkali metal)0-20 % of the weight, and RO(R is alkaline earth metal):0-20% of the weight. And R2O It is desirable that the total quantity of RO is 10 - 30 % of the weight. In the above-mentioned glass, when the glass called soda lime glass is a host phase component, improvement in glass reinforcement is the largest. Moreover, in the silicate glass which the alkali element and the alkaline earth element contain, especially the addition effectiveness of rare earth elements is high. Although many of added rare earth elements dissolve in a glass matrix, some rare earth elements which cannot dissolve to the matrix of them deposit as a very fine particle of a crystalline substance. The solid-solution limit community to the matrix of rare earth elements, i.e., the ease of carrying out of a deposit, changes with classes of matrix. As mentioned above, unless a very fine particle deposits to some extent, the reinforcement of glass does not improve enough. When the silicate glass which the alkali element and alkaline earth element of the above-mentioned presentation contain is used as a matrix, the glass substrate with which were satisfied of the reinforcement which is easy to deposit rare earth elements moderately, and is required of an information record disk, chemical stability, etc. can be manufactured.
[0024] In the 1st invention, it is desirable that the permeability of the visible white light of said glass is 60% or more. In order to use it as a glass substrate for optical disks, it is necessary to control the amount of a deposit particle, and particle size so that the permeability of the visible white light is 60% or more. If permeability is less than 60%, it will decrease, in case the laser beam for recording information on a record medium penetrates the inside of a glass substrate, and the reduction in a S/N ratio etc. will be caused.
[0025] In order to attain the above-mentioned object, according to invention of the 2nd of this invention, moreover, on surface [at least / a part of] Even if it is the glass substrate for information record disks with which the layer for recording information is prepared, and the degrees of hardness of said substrate are 670 or more Hv(s) and the permeability of the visible white light performs 60% or more and heat treatment The glass substrate for information record disks characterized by concentration of an alkali element not taking place to a substrate front face is offered.
[0026] By the above-mentioned configuration, sheet-metal-izing is possible and the glass substrate for information record disks with an unnecessary chemical strengthening can be offered after the grinding on the front face of a substrate.
[0027] Moreover, it is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of] according to invention of the 3rd of this invention, and the thickness of said substrate is 0.38mm. The glass substrate for information record disks which is the following and is characterized by concentration of an alkali element

not taking place to a substrate front face even if the granularity on the front face of a substrate performs 5nm or less and heat treatment by Ra is offered.
[0028] According to the above-mentioned configuration, sheet-metal-izing is possible and the glass substrate for information record disks with an unnecessary chemical strengthening can be offered after the grinding on the front face of a substrate.
[0029] It sets to the 3rd invention and the diameter of the glass substrate for information record disks is 2.5. It is desirable that it is more than an inch.
[0030]
[Embodiment of the Invention]
(Example 1) This invention is hereafter explained to a detail using an example.
[0031] The blending ratio of coal (weight ratio) of the raw material of the glass examined by this invention and glass transition temperature (Tg/degree C), a coefficient of thermal expansion (alphax10-7/degree C), and micro Vickers hardness (Hv) are shown in a table 1.
[0032]
[A table 1]

No.	配合割合（重量比）											Tg (℃)	α	Hv
	SiO_2	CaO	Al_2O_3	MgO	B_2O_3	BaO	SrO	TiO_2	ZnO	Na_2O	Er_2O_3			
1	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	0.0	550	85.0	615
2	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	1.0	560	88.6	621
3	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	2.0	556	90.2	635
4	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	5.0	585	91.3	673
5	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	10.0	582	92.2	683
6	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	15.0	590	93.0	707
7	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	18.0	598	93.5	712
8	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	21.0	608	93.8	722
9	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	32.0	–	–	–
10	75.9	8.0	1.4	4.1	–	–	–	–	–	14.0	0.0	563	85.4	613
11	79.5	8.0	1.4	4.1	–	–	–	–	–	14.0	0.0	570	87.0	617
12	72.5	8.0	4.4	4.1	–	–	–	–	–	14.0	0.0	572	90.3	627
13	72.5	8.0	8.4	4.1	–	–	–	–	–	14.0	0.0	583	90.6	642
14	67.8	–	14.5	–	–	–	–	–	–	17.7	10.0	530	96.6	792
15	50.0	6.0	16.5	7.0	–	–	–	6.5	14.0	–	10.0	545	110.0	720
16	40.0	10.0	17.0	10.0	–	–	–	7.0	16.0	–	10.0	520	126.5	706
17	72.5	8.0	1.4	4.1	7.0	–	–	–	–	7.0	5.0	594	59.5	721
18	72.5	8.0	1.4	4.1	–	15.2	–	–	–	7.0	5.0	605	76.9	686
19	72.5	8.0	1.4	4.1	–	–	10.3	–	–	7.0	5.0	617	76.0	685
20	67.8	–	14.5	–	–	–	–	–	–	17.7	–	520	95.4	735
21	50.0	6.0	16.5	7.0	–	–	–	6.5	14.0	–	–	521	103.0	652
22	40.0	10.0	17.0	10.0	–	–	–	7.0	16.0	–	–	502	122.4	634
23	72.5	8.0	1.4	4.1	7.0	–	–	–	–	7.0	–	594	57.0	710
24	72.5	8.0	1.4	4.1	–	15.2	–	–	–	7.0	–	588	77.9	644
25	72.5	8.0	1.4	4.1	–	–	10.3	–	–	7.0	–	597	72.0	597

表1

[0033] It asked for glass transition temperature and a coefficient of thermal expansion from the thermal expansion curve of glass. The coefficient of thermal expansion was computed from the elongation percentage of the glass from 50 degrees C to 500 degrees C. The programming rate was set as a part for 5-degree-C/, and measuring load was set to 10g. Moreover, quartz glass (coefficient of thermal expansion; 5x10-7/degree C) was used for the reference sample. Moreover, the configuration of a sample was set to 5mmphix20mmH. Ten micro Vickers hardness (Hv) was measured on the measuring load of 100g, and the conditions for load impression time amount 15 seconds, and was taken as the average.
[0034] The glass production approach was carried out as follows. After having carried out weighing capacity of the raw material powder of the defined amount to the crucible made from platinum, putting it in and mixing, it dissolved at 1600 degrees C in the electric furnace. After the raw material fully dissolved, the churning feather made from platinum was inserted in glass melt, and was agitated for about 1 hour. The glass block was obtained by slushing and quenching glass melt after that to the fixture made from a graphite heated by about 300 degrees C in churning feather after putting for 30 minutes, ejection and. The block was reheated to near the glass transition temperature of each glass after that, and distortion and ** were performed by cooling slowly with 1-2-degree-C cooling rate for /.
[0035] The glass of No.1 is glass which uses oxidation silicon as a principal component. This glass was considered as the basic presentation and the rare earth oxide was added to this 100 weight section. No.2-8 are glass which added the oxidization erbium (Er 2O3) which is one of the rare earth oxide one to 21% of the weight among a table 1. Although No.9 were glass which made the oxidization erbium contain 32% of the weight, it was difficult for the raw material powder of Er 2O3 to remain in glass at the time of the glass dissolution, and to obtain uniform glass. No. — 10, 11, and 12 and 13 — the glass 100 weight section of No.1 — receiving — SiO2 And it is glass which was made to increase 2Oaluminum3 addition and was produced.
[0036] The glass of No.14 is glass which was made to increase the content of aluminum 2O3 further, and added Er 2O3 10% of the weight. No. — while 15 or 16 glass makes the content of aluminum 2O3 increase further — SiO2 The content was decreased. Moreover, it is ZnO and TiO2 as a crystallization component. It was made to contain and this was made to contain 10% of the weight of Er 2O3. The glass of No.17 is Na2O. It is glass which made the amount the one half of No.1, added B-2 O3, and added Er 2O3 5% of the weight. furthermore, No. — 18 or 19 glass — Na2O It is glass which made the amount the one half of No.1 and added alkaline-earth-metal oxides, such as BaO and SrO. Moreover, the glass of No.20-23 is glass which is not making Er 2O3 of the glass of No.15-19 contain, respectively.
[0037] Tg, alpha, and Hv of the glass which carried out the chemical strengthening of the glass of No.1 by the alkali permutation are shown in a table 2 as an example of a comparison.
[0038]
[A table 2]

表 2

No.	Tg (℃)	α	Hv	備考
26	557	85	670	化学強化ガラス

[0039] A chemical strengthening is about 0.63mm. It was immersed into the 380-degree C potassium-nitrate solution for 40 minutes, and the glass processed into the plate was performed. The thickness of a chemical-strengthening layer was about 20 micrometers. Hv of chemically strengthened glass was 670. Since Hv of the glass before a chemical strengthening was 615, it turned out that Hv is going up about 9% by the chemical strengthening. Moreover, the coefficient of thermal expansion did not change with chemical strengthenings. Moreover, glass transition temperature rose a little.
[0040] Based on the result of Hv of this chemically strengthened glass, the reinforcement of the glass shown in a table 1 is evaluated. When the additions of Er 2O3 were 1.0 % of the weight and 2.0 % of the weight (2 No. 3), although micro Vickers hardness was carrying out lifting to 621,635 compared with the glass of No.1, respectively, the amount of lifting was small and it did not reach the degree of hardness of chemically strengthened glass. The addition of Er 2O3 is 5.0. With the glass of No.3 of weight %, Hv is 673 and it turned out that Hv of chemically strengthened glass is exceeded. With the glass of No.5-8 the addition of Er 2O3 was made to increase with 10 - 21 % of the weight furthermore, Hv went up further and was set to 683,707,712 and 722, respectively.
[0041] The micro Vickers hardness to the addition of each oxide is shown in drawing 1 . The addition of an axis of abscissa was displayed by mol % of the oxide containing two cations. Namely, SiO2 As Si 2O4, Er 2O3 and aluminum2O3 were taken as the display by oxide conversion as it is. As shown in drawing 1 , with the glass which added Er 2O3, Hv was going up almost linearly to the addition. 2OEr3 addition — 0.013-mol% (5.0 % of the weight) — it became more than Hv of chemically strengthened glass above.

[0042] although the inclination for Hv to go up on the other hand also in Si 2O4 and the glass (No.8-11) which added aluminum2O3 was seen — the amount of lifting — small — more than 0.05mol% — even if it added, the level of chemically strengthened glass was not reached.
[0043] Change of the coefficient of thermal expansion to the addition of each oxide is shown in drawing 2 . With the glass which added Er 2O3, the coefficient of thermal expansion also rose with lifting of an addition. Since the coefficient of thermal expansion of an information record-medium layer was large, matching with an information record-medium layer was good by lifting of the coefficient of thermal expansion of a substrate.
[0044] As mentioned above, when Er 2O3 was added, Hv was able to be raised greatly. The content of Er 2O3 besides the example shown in a table 1 is 0.5. Most lifting of Hv was not seen under by weight %. Therefore, Er 2O3 is 0.5. It is desirable that it is more than weight %. Moreover, when it was made to contain exceeding 30 % of the weight, the oxide made to contain did not dissolve into glass, but became an ununiformity. As for the content of this to Er 2O3, it is desirable that it is 30 or less % of the weight. Moreover, SiO2 considered to raise other mechanical strengths Although the amount of lifting of Tg was almost comparable when the component and the amount of lifting of Hv and Tg which are called aluminum 2O3 were measured, it was more effective to add Er 2O3 about lifting of Hv. Also in the glass to which 2Oaluminum3 content of No.14-16 was made to increase, Hv improved rather than the glass of No.20-22 which did not make Er 2O3 contain. No. — when 15 or 16 glass was heat-treated at 900 degrees C, the crystal grain child deposited in glass and glass became translucent. When Hv was measured in this condition, compared with 760,720 and heat treatment before, Hv was large, respectively. At No.17-19, it is Na2O. The content was decreased to the amount of the one half of No.1. Therefore, since it was possible that characteristic temperature rises, specified quantity content of B-2s O3, BaO, and SrO which are low melting point-ized components was carried out. In these glass, it is 5.0. Er 2O3 of weight % was made to contain. In any case, compared with the glass of No.23-25 which are not making Er 2O3 contain, Hv improved greatly.
[0045] Next, the three-point bending strength test of chemically strengthened glass (No.12) was performed for the glass of No.1, the glass of No.5, and a comparison. a table 3 — the average (sigma/MPa) of three-point bending reinforcement — it is shown.
[0046]
[A table 3]

表 3

No.	n	σ (MPa)
1	20	328
5	20	391
26	20	390

[0047] Assessment is 0.63mm in glass thickness, width of face of 2mm, and die length of 3mm. It carried out using the test piece. A lower span is 1.2mm. It carried out. The number of test pieces (n) was set to 20 also with each sample. If the added load is set to w, the three-point bending reinforcement sigma (MPa) will become sigma= (3lw/2at2). Here, they are an l; lower span, the width of face of a; test piece, and the thickness of t; test piece. The three-point bending reinforcement of an average of the glass of No.1 was 328MPa(s). It is Er 2O3 10.0 With the glass of No.5 weight % content of was done, reinforcement of average three-point bending reinforcement was improving about 19% with 391, and it had reinforcement equivalent to chemically strengthened glass (No.26).
[0048] in order [next,] to examine the mechanism of the improvement in a mechanical strength by making a rare earth oxide contain — a transmission electron microscope — No.1- the microstructure of the glass of 8 and 10 was observed.
[0049] The glass which reaches and does not contain the rare earth oxide of 10 was a homogeneous amorphous state No.1. On the other hand, with the glass of No.2-8, the detailed particle of nano order deposited in the amorphous glass matrix. Observation of a high-resolution image showed that these particles were crystalline substances. Thus, in the glass containing a rare earth oxide, the particle was observed and the degree of the improvement in a mechanical strength was large. On the other hand with the glass which made the aluminum2O3 grade contain like the glass of No.10, the particle was not observed in glass, but the degree of the

improvement in on the strength was also small. From this, it is thought that reinforcement improved by existence of this very fine particle.
[0050] The particle size of this microcrystal particle changed with 2OEr3 contents. The mean particle diameter of the particle produced on each glass and the permeability of the white light are shown in a table 4.
[0051]
[A table 4]

表 4

No.	2	3	4	5	6	7	8
Er_2O_3含有量（重量比）	1.0	2.0	5.0	10.0	15.0	16.0	21.0
平均粒径(nm)	1	3	8	15	38	51	103
透過率(%)	91	85	79	74	70	67	58

[0052] Moreover, the relation of the mean particle diameter of the microcrystal particle to 2OEr3 addition which deposits, and the permeability of glass is shown in drawing 3 and drawing 4 . Mean particle diameter was rising in proportion to the 2nd [about] power of 2OEr3 addition. Permeability decreased in proportion to negative [of 2OEr3 addition]. Although the permeability of the white light was efficient at 60% or more and record playback was performed when the permeability of light and the effectiveness of optical information record were investigated, record playback with a well head was not able to be performed at less than 60%. Therefore, as for the permeability of the white light, it is desirable that it is 60% or more. The mean particle diameter of the glass of No.16 was 51nm, and the rate of the volume of the particle calculated from a TEM photograph was 22%. From these things, if mean particle diameter exceeds 50nm, the rate of the volume of a particle will increase and the permeability of the white light will decrease. For this reason, it is not desirable, if 2OEr3 content exceeds 16 % of the weight, the mean particle diameter of a deposit particle exceeds 50nm and the rate of the volume of a deposit particle exceeds 20% further.
[0053] Next, it inquired by making the glass of No.1 contain various rare earth elements. The class of added rare earth elements and the glass transition temperature (Tg) of the obtained glass, a coefficient of thermal expansion, and micro Vickers hardness (Hv) are shown in a table 5. The relation between Hv and Tg in the rare earth elements added to drawing 5 and drawing 6 is shown. The oxide of Ln 2O3 performed addition. The addition was made into 0.026-mol% also with each oxide. The production approach of glass and the measuring method of a property are the same as that of a table 1.
[0054]
[A table 5]

表 5

No.	Ln	Ln_2O_3 含有量（重量比）	Tg (℃)	α	Hv
27	Sc	3.58	593	91.4	666
28	Y	5.89	582	81.6	653
29	La	8.47	583	90.2	650
30	Ce	8.53	582	91.3	648
31	Pr	8.61	585	92.2	651
32	Nd	8.78	587	86.4	646
33	Sm	9.07	584	93.5	651
34	Eu	9.19	585	95.5	652
35	Gd	9.46	580	90.9	685
36	Tb	9.51	583	90.3	682
37	Dy	9.70	581	90.6	683
38	Ho	9.82	584	91.6	682
39	Er	10.00	582	92.2	683
40	Tm	10.03	588	92.0	682
41	Yb	10.30	588	90.9	685
42	Lu	10.40	585	91.1	684

[0055] It was going up, even when micro Vickers hardness was seen, and which rare earth elements were added. When the amount of lifting was seen, the direction at the time of adding the so-called heavy-rare-earth element by the side of a heavy element from Gd 2O3 was large. The value of those degrees of hardness was 680 or more, and was larger than Hv of chemically strengthened glass. On the other hand, in the case where the light-rare-earth element from Sc 2O3 to Eu 2O3 is added, it was less from the level of chemically strengthened glass 650 order.
[0056] In the case of every element, glass transition temperature was fixed at about 585 degrees C. The range of a coefficient of thermal expansion was 81.6 - 92.2x10-7/degree C, and matching with an information record-medium layer was good. As a class of rare earth elements to add, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu are more desirable than the above examination.
[0057] When the structure of glass of No.21 containing Gd 2O3 was observed by TEM, the same microcrystal particle as the glass

which added Er 2O3 was observed. Mean particle diameter was 15nm.
[0058] Next, the presentation of mother glass was considered. SiO2 At less than 40 % of the weight, since a mechanical strength and chemical stability were spoiled, a content was not desirable. Moreover, SiO2 When the content exceeded 80 % of the weight, melting nature fell and many striae occurred. Moreover, the coefficient of thermal expansion became small too much, and was unsuitable as glass for substrates. As mentioned above, SiO2 As for a content, it is desirable that it is 40 % of the weight - 80 % of the weight.
[0059] When **** glass was made to contain B-2 O3, it excelled in the fluidity and the glass of a proper coefficient of thermal expansion was obtained. However, when the content exceeded 20 % of the weight, the effectiveness of the improvement in a mechanical strength by rare earth content became small. For this reason, as for the content of B-2 O3, it is desirable that it is 20 or less % of the weight.
[0060] Next, the alkali-metal oxide was examined. When the sum total of the content of an alkali-metal oxide (Li2O, Na2O, K2O) exceeded 20 % of the weight, chemical stability fell. As for the sum total of the content of this to an alkali-metal oxide, it is desirable that it is 0 - 20 % of the weight. Furthermore, when it exceeded 20 % of the weight similarly about the alkaline-earth-metal oxide, chemical stability fell. As for the sum total of the content of this to an alkaline-earth-metal oxide, it is desirable that it is 0 - 20 % of the weight.
[0061] Although the same effectiveness was seen in the semantics which makes glass form into the low melting point, the total quantity of the fluidity was bad at less than 10 % of the weight, and the stria generated many alkali-metal oxides, alkaline-earth-metal oxides, and B-2s O3. Moreover, when it exceeded 30 % of the weight, chemical stability fell. As for the sum total of the content of the alkali-metal oxide from this, an alkaline-earth-metal oxide, and B-2 O3, it is desirable that it is 10 - 30 % of the weight.
[0062] Moreover, although it was effective for making the mechanical strength and chemical stability of glass increase, the fluidity of glass fell and aluminum 2O3 was not desirable, when the content exceeded 17 % of the weight. Therefore, as for the content of aluminum 2O3, it is desirable that it is 17 or less % of the weight.
[0063] Moreover, since raw material powder remained in glass at the time of the glass dissolution if it exceeds 30 % of the weight, it was difficult for the content of a rare earth oxide to obtain uniform glass, and it was not desirable. The effectiveness of improvement in a mechanical strength was acquired by addition of such a little rare earth oxide that there is little sum total of the content of an alkali-metal oxide. When the total quantity of an alkali-metal oxide and an alkaline-earth-metal oxide was 10 % of the weight, improvement in a mechanical strength was found for the addition of a rare earth oxide even at least 0.5% of the weight. However, 0.5 The effectiveness of the improvement in a mechanical strength was small at under weight %. Therefore, as for the content of a rare earth oxide, it is desirable that it is 0.5 - 30 % of the weight.
[0064] The glass substrate of this invention has obtained sufficient reinforcement by having added rare earth elements. Therefore, with the conventional glass substrate, the required chemical strengthening can be performed as it is unnecessary. That is, it is characterized by there being no compression consolidation layer which made the glass front face produce residual stress. The existence of a surface compression consolidation layer irradiates a laser beam from a front face, and can be measured by the approach of carrying out the spectrum of the reflected light using prism. When the glass substrate of this invention was measured by the above-mentioned approach, there is almost no residual-stress difference in the interior of a glass substrate and a front face, namely, it was checked that there is no surface stress layer.
[0065] Next, the actual substrate was produced using the glass of an example and the property was evaluated. The glass of No.1, and 5, 7, 8, 18 and 35 was used for glass. Moreover, the chemically-strengthened-glass substrate of No.26 and the SiO2-aluminum2O3-ZnO-MgO-RO system glass-ceramics substrate shown in a table 6 were evaluated as an example of a comparison.
[0066]
[A table 6]

表 6

No.	Tg (℃)	α	Hv	備　考
43	780	114	720	結晶化ガラス

[0067] The produced glass substrate is 65mmphi and 0.635mmt. It carried out. The permeability of the water resisting property of the obtained substrate, thermal resistance, surface roughness, and the white light is shown in a table 7.
[0068]
[A table 7]

表 7

No.	耐水性 アルカリ濃度(ppm)	耐熱性	表面粗さ Ra(A)	透過率 (%)
5	10.0	○	4	74.0
35	15.0	○	4	94.0
26	312.0	△	4	95.0
43	2.0	○	9	15.0
1	11.0	○	4	94.0
7	11.5	○	5	[illegible].0
8	10.7	○	10	58.0
18	4.0	○	5	79.0

[0069] A water resisting property is immersed in 80ml of 70-degree C hot pure water in a substrate for 20 hours, detects the total alkali and the amount of alkaline earth elements which were eluted the inside of pure, and is ppm about a total elution volume. It displayed. Thermal resistance heated the substrate at 350 degrees C among the vacuum, and carried out secondary ion mass spectroscopy of the surface section after that. What diffusion of alkali ion was regarded as by the surface layer was displayed by **, and what was not seen was displayed by O. Average surface roughness Ra (A) estimated surface roughness using the surface roughness meter. Moreover, permeability irradiated the source substrate front face of the white light, and it asked for it by the intensity ratio of incident light and the transmitted light.
[0070] When the water resisting property was seen, there were few amounts of elution alkali and it was good at No.1, and 5, 7, 8, 18, 35 and 43. In the chemically strengthened glass of No.26, there were many elution volumes of alkali and they were not able to say it as fitness.
[0071] In the heat resistance test, it turned out similarly with the chemically-strengthened-glass substrate of No.26 that many alkali elements were detected by the surface layer and migration of ion has taken place. As mentioned above, in the glass substrate which carried out the chemical strengthening, it was easy to produce migration of an alkali element, and thermal and chemical stability was good in the glass substrate of this invention to having been unstable.
[0072] Next, when surface roughness was seen, in the glass substrate of No.1, and 7, 18, 5, 35 and 26, Ra=4-5A and good smooth nature were obtained. on the other hand — No. — with 8 or 43 glass, it became Ra=9-10A and a big value.
[0073] The permeability of the white light was as good as 67 - 95% at No.1, and 7, 5, 18, 35 and 26. No. — with 8 or 43 glass, permeability was as low as 58 or 15%.
[0074] It investigated about the relation of the deposit condition of surface roughness and a particle. With the glass of No.7, the content of Er 2O3 was 16 % of the weight, and the mean particle diameter of the particle which deposits was 51nm. Moreover, the rate of the volume of a particle was 40%. At this time, permeability was 67%. On the other hand, with the glass of No.8, the content of Er 2O3 was 21 % of the weight, the mean particle diameter of the particle which deposits was 103nm, and the rate of the volume of a particle was 72%. Moreover, permeability was 58%. At this time, surface roughness is 10.0A at the glass of 5.0A and No.8 with the glass of No.7. 2 double front face was coarse. Thus, it turned out that 2OEr3 content exceeds 20 % of the weight, and mean particle diameter exceeds 100nm, surface roughness is coarse and permeability is inferior to smooth nature in it at less than 60%.
[0075] As for the content of the rare earth oxide of the above thing to Er2O3 grade, it is desirable that it is 20 or less % of the weight. As for mean particle diameter, it is still more desirable that it is 100nm or less. Moreover, as for permeability, it is desirable that it is 60% or more. If the above conditions are fulfilled, smooth nature small enough can be obtained.
[0076] The magnetic film was formed in the eight above-mentioned kinds of glass substrates, the magnetic disk was produced, and the property was evaluated. The film configuration of the produced magnetic disk is shown in drawing 8 . drawing 8 — setting — 1 -- for Cr substrate film and 4, as for C protective coat and 6, a CoCr system magnetic film and 5 are [a glass substrate and 2 / Cr precoat film and 3 / an etching texture and 7] lubricating film.
[0077] 50nm and 50nm of CoCr system magnetic films were formed [Cr precoat film] for 25nm and Cr substrate film after washing the magnetic glass substrate of 65mmphi. The etching texture was given for the carbon protective coat after 10nm formation. After tape cleaning, lubricating film 7 was applied and it considered as the magnetic disk. In addition, membrane formation was given to substrate both sides. Then, the existence of the pervasion situation by the alkali of the magnetic film of a magnetic disk and film peeling was evaluated. The magnetic disk drive was produced using this magnetic disk. The schematic diagram of the magnetic disk drive produced to drawing 10 is shown. For a revolving shaft and 10, as for the magnetic head and 12, in drawing 10 , a spindle motor and 11 are [the magnetic disk which showed 8 to drawing 8 , and 9 / a magnetic-head revolving shaft and 13] the output terminals of an electric system. The revolving shaft 9 was equipped with the magnetic disk 8 of six sheets in equipment. The magnetic head 11 was allotted to each two substrate both sides. The control system etc. was connected and it considered as the magnetic disk drive. The head flying height under magnetic-disk revolution could be 40nm.
[0078] Record reproducing characteristics were evaluated using this magnetic disk drive. An alkali pervasion situation, film peeling, and record reproducing characteristics are shown in a table 8.
[0079]
[A table 8]

表 8

No.	アルカリ侵食	膜剥がれ	記録再生特性
5	○	○	○
21	○	○	○
12	△	△	○
29	○	○	△

[0080] The alkali pervasion situation made ** O and 5% or more of case, when the percentage of a magnetic disk that pervasion was seen among the obtained magnetic disks was less than 5%. Film peeling was evaluated similarly. Record reproducing characteristics displayed the good thing by O, and displayed the not good thing by **. The magnetic disk of this invention had little alkali pervasion and film peeling, and its record reproducing characteristics were also good. In the chemically strengthened glass of No.12, alkali pervasion and film peeling were seen notably, and it was not desirable. Moreover, although alkali pervasion, film peeling, etc. were not seen, its record reproducing characteristics were not good at glass-ceramics No.29. Next, the glass substrate was produced using various glass of this invention, and the shock-proof trial was performed. The shock-proof trial formed the magnetic film, the protective coat, etc., produced the magnetic disk of the membrane structure shown in drawing 8 , and evaluated it by the process same to both sides of a glass substrate as the above-mentioned using this disk. The test method fixed the produced disk to the fixture, and performed it by making a dummy head collide with a disk with an accelerator. this trial -- one kind of magnetic disk -- receiving -- 30 points -- carrying out -- a crack -- applying -- etc. -- the frequency of the point out of which the defect came estimated. No.1-5 of a table 1 and the glass of 14, 18, 23, 24, 25, 26, and 43 were used for the glass for substrates. A test result is shown in drawing 7 . The defect frequency [according / an axis of ordinate / to an exam] according [an axis of abscissa] to Hv of each glass was displayed by %. By the degree of hardness not more than it, the defect was seen for the degree of hardness of glass bordering on 670, and the amount rose as the degree of hardness fell. Moreover, the defect in an exam was not seen or more by 670. With [a glass substrate degree of hardness] 670 [or more], from the above thing, the magnetic disk which can be equal to a shock-proof trial is producible.
[0081] The optical disk and the optical disk unit were produced similarly. When the glass substrate of this invention was used, there was also almost no film peeling of a record-medium layer, and it was efficient and record playback was able to be carried out.
[0082] As mentioned above, the information record disk of this invention was excellent in chemical stability, and there were also few defects, such as film peeling. Moreover, the record reproducing characteristics of an information record disk unit were also good. Since neither chemical-strengthening processing nor crystallization processing was furthermore performed to a glass substrate, a disk and equipment were producible to low cost.
[0083] (Example 2) The magnetic disk of the configuration shown in drawing 9 using the glass substrate of this invention was produced. Thickness of a substrate was set to 0.38mm. Moreover, the glass of No.5 which have not carried out chemical-strengthening processing was used for glass. Moreover, the precoat film usually given was not formed but the direct magnetic thin film was formed on the glass substrate. the surface roughness of a glass substrate -- Ra=4.0A it was . The magnetic disk which used as the substrate the soda lime glass which performed alkali consolidation processing as an example of a comparison, the usual soda lime glass which has not performed alkali consolidation processing, and crystallization glass was also produced.
[0084] The caustic embrittlement of reinforcement, smooth nature, and a magnetic film and the assessment result about magnetic properties are shown in a table 9. ** estimated what cannot say a property for a good thing with O and fitness.
[0085]
[A table 9]

表 9

基板	強度	平滑性	磁性膜のアルカリ腐食	磁気特性	備考
No.5ガラス	○	○	○	○	実施例
化学強化ソーダライムガラス	○	○	△	△	比較例
化学強化なしソーダライムガラス	△	○	○	○	比較例
結晶化ガラス	○	△	○	△	比較例

[0086] With the magnetic disk of this invention, reinforcement is high and it is 0.380mm. Reinforcement sufficient also by thinness was obtained. Moreover, smooth nature was also good. Even if the corrosion of a magnetic film was not seen, either and it did not form the precoat film, a magnetic film did not deteriorate. Moreover, since smooth nature was good, the flying height of the magnetic head could also be set to 30nm or less, and magnetic properties were also good.
[0087] With the soda lime glass which carried out chemical-strengthening processing, as a result of the alkali component of glass eating a magnetic film away since there is no precoat film although the high mechanical strength was obtained, many things in which the alkali component has adhered to the floatation side of the magnetic head after a system sliding trial were seen. Moreover, that in which the magnetic film has exfoliated after sliding was also seen. On the whole also in the magnetic disk with which a defect was not seen, magnetic properties were falling. The magnetic disk of reinforcement using the soda lime glass which has not carried out a chemical strengthening was inadequate. In glass ceramics, surface roughness was large, since smooth nature was not good,

the flying height of the magnetic head was large, and sufficient magnetic properties were not acquired.
[0088]
[Effect of the Invention] According to invention of the 1st of this invention, since it has sufficient mechanical strength, sheet-metal-izing is possible, and since it excels in chemical stability and homogeneity, the disk for information record without the need of preparing an interlayer can be offered.
[0089] Since the number of sheets of the magnetic disk per volume can be made [many] according to invention of the 2nd of this invention, if it is the same recording density, a small and lightweight magnetic disk drive can be offered. Moreover, a magnetic-recording medium being influenced by the structure of an interlayer and presentation, and reducing a magnetic property is lost.
[0090] According to invention of the 3rd of this invention, it becomes possible to expand the allowance width of face of the manufacture error of a disk.
[0091] According to invention of the 4th of this invention, even if it enlarges a polish rate to some extent in the case of the surface polish after the handling at the time of manufacture, for example, glass casting, improvement in the yield can be aimed at by handling of the substrate haulage after manufacture which a crack does not generate on a front face becoming easy etc., and reduction of a manufacturing cost can be aimed at.
[0092] According to invention of the 5th of this invention, since the manufacturing cost is small, a mass information record disk unit is offered cheaply.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to glass substrates for disks, such as a glass substrate for magnetic disks for cover-half magnetic-disk recording apparatus which was applied to the glass substrate for information record disks, especially was excellent in high intensity at chemical stability, thermal stability, and smooth nature, a glass substrate for magneto-optic disks for optical-magnetic disc equipment, an optical disk using the phase transformation of a crystal, and DVD (digital video disc).

[Translation done.]

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PRIOR ART

[Description of the Prior Art] As an information recording apparatus of a mainframe computer or a personal computer, current, a magnetic disk drive, and optical-magnetic disc equipment are in use. Information recording density is increasing these information recording device every year with the formation of small lightweight of equipment, and improvement in the speed of an information R/W rate. For example, in the magnetic disk drive, although 8.8 inches of the diameter of the disk substrate of several years ago were a criterion, in recent years, small magnetic-disk substrates, such as 3.5, 2.5, and 1.8 inch, are developed. Moreover, not only the cutback of the diameter of a disk but disk substrate thickness is 0.63mm. It is thin the following. Therefore, the high intensity substrate is called for also compared with the former. Moreover, the flying height of a head and a medium is becoming small and the smooth nature of the substrate which can control this flying height is called for.
[0003] The aluminum alloy was used for the conventional substrate for magnetic disks. However, that it is easy to deform, since hardness was still more inadequate, the aluminium alloy had the problem that it could not be said that the smooth nature on the front face of a disk after polish is enough. Moreover, when a head contacted a magnetic disk mechanically, there was a problem that a magnetic-recording medium layer tends to exfoliate. Therefore, there is little deformation and development of a large glass substrate of a mechanical strength with good and smooth nature is furthered. Since this glass substrate can be used also as a substrate the magneto-optic disk with which translucency is required of the substrate itself, and for optical disks, it is named generically below the glass substrate for information record disks.
[0004] When current and the above-mentioned glass substrate for information record disks permute the alkali element on the front face of a substrate by other alkali elements, the chemically strengthened glass which raised the mechanical strength, and the glass ceramics which deposited the detailed crystalline substance particle in amorphous glass are developed. However, in chemically strengthened glass, since an alkali permutation layer existed in a front face, at the time of substrate washing, moved to the front face at the time of the heating process at the time of alkali ion being magnetic film membrane formation, and it was eluted, the magnetic film was eaten away, and there was concern which degrades membranous bond strength. For this reason, in JP,7-223845,A, the chemically strengthened glass which was excellent in chemical durability by performing a chemical treatment further after the chemical strengthening has been obtained.
[0005] On the other hand, in glass ceramics, the irregularity after surface polish was not able to say that it was large and smooth nature was enough from the difference in the abrasiveness of the microcrystal particle and amorphous glass to produce. Therefore, it was difficult to deal with lowering of the flying height of a head. In JP,7-300340,A, smooth nature is raised by making a crystal grain child's particle size detailed with 5-100nm.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to invention of the 1st of this invention, since it has sufficient mechanical strength, sheet-metal-izing is possible, and since it excels in chemical stability and homogeneity, the disk for information record without the need of preparing an interlayer can be offered.
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[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, there is a problem that it is still difficult to make the property of the substrate after the chemical strengthening in chemical-strengthening down stream processing and a polish process into homogeneity, also with the chemical-strengthening technique of JP,7-223845,A. Furthermore, since the problem on which alkali ion eats a magnetic film away is not solved thoroughly, it is necessary to prepare the interlayer which prevents diffusion of alkali ion between a magnetic film and a glass substrate. Moreover, in order that a substrate may color it opalescence with the glass-ceramics technique of JP,7-300340,A, translucency is low, and application to the substrate for information record media using light is difficult. Moreover, since a highly precise crystallization process is required, there is a problem that it is difficult to make the property of a substrate into homogeneity.
[0007] moreover, the above — since after-treatment processes, such as chemical-strengthening down stream processing and a crystallization process, are required even when which approach is used, low-cost-izing is difficult.
[0008] The object of this invention is to offer the glass substrate for information record disks which has sufficient mechanical strength, chemical stability, and light transmission nature, and can be manufactured in a short-time process.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned object, according to invention of the 1st of this invention, it is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of], and the glass substrate for information record disks characterized by said substrate consisting of glass containing rare earth elements is offered.
[0010] The magnetic medium layer prepared directly on the surface of a substrate, or indirectly [the layer for recording the above-mentioned information], the layer of the matter which causes a phase transformation by the exposure of light, Or if it is layers which information is recorded and can read the information, such as a layer of the matter which is recording information by preparing matter or a mechanical level difference etc. from which the reflection factor of light differs, this invention is applicable no matter it may be what thing. It is preparing between the layer for recording information for an interlayer (precoat film) etc. as preparing the layer for recording the above-mentioned information in a front face indirectly, and a glass substrate. For example, improvement in bond strength can be aimed at, or this invention is applicable even if it is a configuration for adding the object of controlling a chemical reaction.
[0011] I hear that both sides of a disk disk side or one side is sufficient as surface [at least / a part of], and a case as the layer for recording information only on a periphery and inner circumference side also in respect of the same further is prepared is sufficient as it, and it is.
[0012] The glass substrate for information record disks which has sufficient mechanical strength, chemical stability, and light transmission nature, and can be manufactured in a short-time process by the above-mentioned configuration can be offered.
[0013] In the 1st invention, it is desirable that the very fine particle is distributing on said glass, and said rare earth elements are contained in this very fine particle.
[0014] There is an upper limit (solid-solution limit) in the amount of the rare earth elements which can melt during the glass organization which has the network structure, and if the rare earth elements of the amount exceeding an upper limit are added, it deposits in a glass host phase as a crystal phase or an amorphous phase. The particle which consists of such a crystal phase or an amorphous phase is called the very fine particle. Also when distribution of rare earth elements is an ununiformity, and a very fine particle deposits exceeding a solid-solution limit selectively, for a certain reason, the content of rare earth elements does not necessarily need to be over the solid-solution limit of host phase glass. As for rare earth elements, it is desirable to exist in both of a very fine particle the inside of a glass host phase. Moreover, as for a very fine particle, it is desirable that it is a crystalline substance. If whether it is a crystalline substance observes a lattice image for example, with a transmission electron microscope photograph, the part of a crystalline substance can be easily judged from plaid not being observed into the part of glassiness (amorphous) to plaid being observed.
[0015] In order to carry out the operation to which a particle controls deformation of a glass host phase and destruction for stress also in the carrier beam case when the very fine particle is distributing in a glass host phase, the reinforcement of glass improves more. In this case, the particle currently distributed has [to distribute to homogeneity] the detailed and higher improvement effectiveness in on the strength.
[0016] Moreover, in the 1st invention, said rare earth elements are oxide conversion of Ln_2O_3 (Ln is rare earth elements), and it is desirable to contain 0.5 to 30% of the weight to the whole glass. Furthermore, it is desirable to make rare earth elements into 0.5 - 20 % of the weight. The content of rare earth elements is 0.5. The improvement effectiveness of a mechanical strength is small at under weight %. It is difficult for the raw material powder of a rare-earth-elements oxide to remain at the time of the glass dissolution, if it exceeds 30 % of the weight, and to obtain uniform glass. Moreover, if ******** of rare earth elements is exceeded, the particle size of a very fine particle will become large, and the surface roughness of a substrate will become large.
[0017] The flying height of the magnetic head is more small, and it is desirable to carry out the content of rare earth elements to 20 or less % of the weight to the magnetic disk drive of high recording density.
[0018] In the 1st invention, it is desirable that they are at least one or more sorts as which rare earth elements were chosen from Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu. Since the ionic radius of rare earth elements is large, they tend to deposit in a glass host phase as a very fine particle. Also in rare earth elements, the above-mentioned element is the easiest to deposit a very fine particle in homogeneity in a glass host phase, and its improvement effectiveness in on the strength is high.
[0019] As for the mean particle diameter of a very fine particle, it is desirable that it is 1-100nm.
[0020] The rate of the volume of the grain child to whom mean particle diameter exceeds 100nm increases, and the surface roughness of a substrate becomes large. The flying height of the magnetic head is more small, and it is desirable to set mean particle diameter of rare earth elements to 100nm or less to the magnetic disk drive of high recording density. Moreover, when mean particle diameter is 1nm or less, the strong improvement effectiveness is small.
[0021] It is desirable that the above-mentioned very fine particle is 40% or less at the rate of the volume to the whole glass.
[0022] It is not desirable as the surface roughness of a substrate becomes large when the rate of the volume of a deposit particle exceeds 40%, and stated above.
[0023] In the 1st invention, said rare earth elements are oxide conversion of Ln_2O_3 (Ln is rare earth elements). Contain 0.5 to 20% of the weight to the whole glass, and 2O3:0 - 10 % of the weight of aluminum is included as other components 2:40 - 80 % of the weight of SiO(s), B_2O_3:0-20 % of the weight, R_2O:(R is alkali metal)0-20 % of the weight, and RO(R is alkaline earth metal):0-20% of the weight. And R_2O It is desirable that the total quantity of RO is 10 - 30 % of the weight. In the above-mentioned glass, when the glass called soda lime glass is a host phase component, improvement in glass reinforcement is the largest. Moreover, in the

silicate glass which the alkali element and the alkaline earth element contain, especially the addition effectiveness of rare earth elements is high. Although many of added rare earth elements dissolve in a glass matrix, some rare earth elements which cannot dissolve to the matrix of them deposit as a very fine particle of a crystalline substance. The solid-solution limit community to the matrix of rare earth elements, i.e., the ease of carrying out of a deposit, changes with classes of matrix. As mentioned above, unless a very fine particle deposits to some extent, the reinforcement of glass does not improve enough. When the silicate glass which the alkali element and alkaline earth element of the above-mentioned presentation contain is used as a matrix, the glass substrate with which were satisfied of the reinforcement which is easy to deposit rare earth elements moderately, and is required of an information record disk, chemical stability, etc. can be manufactured.
[0024] In the 1st invention, it is desirable that the permeability of the visible white light of said glass is 60% or more. In order to use it as a glass substrate for optical disks, it is necessary to control the amount of a deposit particle, and particle size so that the permeability of the visible white light is 60% or more. If permeability is less than 60%, it will decrease, in case the laser beam for recording information on a record medium penetrates the inside of a glass substrate, and the reduction in a S/N ratio etc. will be caused.
[0025] In order to attain the above-mentioned object, according to invention of the 2nd of this invention, moreover, on surface [at least / a part of] Even if it is the glass substrate for information record disks with which the layer for recording information is prepared, and the degrees of hardness of said substrate are 670 or more Hv(s) and the permeability of the visible white light performs 60% or more and heat treatment The glass substrate for information record disks characterized by concentration of an alkali element not taking place to a substrate front face is offered.
[0026] By the above-mentioned configuration, sheet-metal-izing is possible and the glass substrate for information record disks with an unnecessary chemical strengthening can be offered after the grinding on the front face of a substrate.
[0027] Moreover, it is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of] according to invention of the 3rd of this invention, and the thickness of said substrate is 0.38mm. The glass substrate for information record disks which is the following and is characterized by concentration of an alkali element not taking place to a substrate front face even if the granularity on the front face of a substrate performs 5nm or less and heat treatment by Ra is offered.
[0028] According to the above-mentioned configuration, sheet-metal-izing is possible and the glass substrate for information record disks with an unnecessary chemical strengthening can be offered after the grinding on the front face of a substrate.
[0029] It sets to the 3rd invention and the diameter of the glass substrate for information record disks is 2.5. It is desirable that it is more than an inch.
[0030]
[Embodiment of the Invention]
(Example 1) This invention is hereafter explained to a detail using an example.
[0031] The blending ratio of coal (weight ratio) of the raw material of the glass examined by this invention and glass transition temperature (Tg/degree C), a coefficient of thermal expansion (alphax10-7/degree C), and micro Vickers hardness (Hv) are shown in a table 1.
[0032]
[A table 1]

No.	配合割合(重量比)											Tg (℃)	α	Hv
	SiO_2	CaO	Al_2O_3	MgO	B_2O_3	BaO	SrO	TiO_2	ZnO	Na_2O	Er_2O_3			
1	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	0.0	550	85.0	615
2	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	1.0	560	88.6	621
3	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	2.0	556	90.2	635
4	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	5.0	585	91.3	673
5	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	10.0	582	92.2	683
6	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	15.0	590	93.0	707
7	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	16.0	598	93.5	712
8	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	21.0	608	93.8	722
9	72.5	8.0	1.4	4.1	–	–	–	–	–	14.0	32.0	–	–	–
10	75.9	8.0	1.4	4.1	–	–	–	–	–	14.0	0.0	563	85.4	613
11	78.5	8.0	1.4	4.1	–	–	–	–	–	14.0	0.0	570	87.0	617
12	72.5	8.0	4.4	4.1	–	–	–	–	–	14.0	0.0	572	90.3	627
13	72.5	8.0	8.4	4.1	–	–	–	–	–	14.0	0.0	583	90.6	642
14	67.8	–	14.5	–	–	–	–	–	–	17.7	10.0	530	96.6	792
15	50.0	6.0	16.5	7.0	–	–	–	6.5	14.0	–	10.0	545	110.0	720
16	40.0	10.0	17.0	10.0	–	–	–	7.0	16.0	–	10.0	520	126.5	708
17	72.5	8.0	1.4	4.1	7.0	–	–	–	–	7.0	5.0	594	59.5	721
18	72.5	8.0	1.4	4.1	–	15.2	–	–	–	7.0	5.0	605	76.9	686
19	72.5	8.0	1.4	4.1	–	–	10.3	–	–	7.0	5.0	617	76.0	685
20	67.8	–	14.5	–	–	–	–	–	–	17.7	–	520	95.4	735
21	50.0	6.0	16.5	7.0	–	–	–	6.5	14.0	–	–	521	103.0	652
22	40.0	10.0	17.0	10.0	–	–	–	7.0	16.0	–	–	502	122.4	634
23	72.5	8.0	1.4	4.1	7.0	–	–	–	–	7.0	–	594	57.0	710
24	72.5	8.0	1.4	4.1	–	15.2	–	–	–	7.0	–	588	77.9	644
25	72.5	8.0	1.4	4.1	–	–	10.3	–	–	7.0	–	597	72.0	597

[0033] It asked for glass transition temperature and a coefficient of thermal expansion from the thermal expansion curve of glass. The coefficient of thermal expansion was computed from the elongation percentage of the glass from 50 degrees C to 500 degrees C. The programming rate was set as a part for 5-degree-C/, and measuring load was set to 10g. Moreover, quartz glass (coefficient of thermal expansion; 5x10-7/degree C) was used for the reference sample. Moreover, the configuration of a sample was set to 5mmphix20mmH. Ten micro Vickers hardness (Hv) was measured on the measuring load of 100g, and the conditions for load impression time amount 15 seconds, and was taken as the average.
[0034] The glass production approach was carried out as follows. After having carried out weighing capacity of the raw material powder of the defined amount to the crucible made from platinum, putting it in and mixing, it dissolved at 1600 degrees C in the

electric furnace. After the raw material fully dissolved, the churning feather made from platinum was inserted in glass melt, and was agitated for about 1 hour. The glass block was obtained by slushing and quenching glass melt after that to the fixture made from a graphite heated by about 300 degrees C in churning feather after putting for 30 minutes, ejection and. The block was reheated to near the glass transition temperature of each glass after that, and distortion and ** were performed by cooling slowly with 1-2-degree-C cooling rate for /.

[0035] The glass of No.1 is glass which uses oxidation silicon as a principal component. This glass was considered as the basic presentation and the rare earth oxide was added to this 100 weight section. No.2-8 are glass which added the oxidization erbium (Er 2O3) which is one of the rare earth oxide one to 21% of the weight among a table 1. Although No.9 were glass which made the oxidization erbium contain 32% of the weight, it was difficult for the raw material powder of Er 2O3 to remain in glass at the time of the glass dissolution, and to obtain uniform glass. No. — 10, 11, and 12 and 13 — the glass 100 weight section of No.1 — receiving — SiO2 And it is glass which was made to increase 2Oaluminum3 addition and was produced.

[0036] The glass of No.14 is glass which was made to increase the content of aluminum 2O3 further, and added Er 2O3 10% of the weight. No. — while 15 or 16 glass makes the content of aluminum 2O3 increase further — SiO2 The content was decreased. Moreover, it is ZnO and TiO2 as a crystallization component. It was made to contain and this was made to contain 10% of the weight of Er 2O3. The glass of No.17 is Na2O. It is glass which made the amount the one half of No.1, added B-2 O3, and added Er 2O3 5% of the weight. furthermore, No. — 18 or 19 glass — Na2O It is glass which made the amount the one half of No.1 and added alkaline-earth-metal oxides, such as BaO and SrO. Moreover, the glass of No.20-23 is glass which is not making Er 2O3 of the glass of No.15-19 contain, respectively.

[0037] Tg, alpha, and Hv of the glass which carried out the chemical strengthening of the glass of No.1 by the alkali permutation are shown in a table 2 as an example of a comparison.

[0038]

[A table 2]

表 2

No.	Tg (℃)	α	Hv	備　考
26	557	85	670	化学強化ガラス

[0039] A chemical strengthening is about 0.63mm. It was immersed into the 380-degree C potassium-nitrate solution for 40 minutes, and the glass processed into the plate was performed. The thickness of a chemical-strengthening layer was about 20 micrometers. Hv of chemically strengthened glass was 670. Since Hv of the glass before a chemical strengthening was 615, it turned out that Hv is going up about 9% by the chemical strengthening. Moreover, the coefficient of thermal expansion did not change with chemical strengthenings. Moreover, glass transition temperature rose a little.

[0040] Based on the result of Hv of this chemically strengthened glass, the reinforcement of the glass shown in a table 1 is evaluated. When the additions of Er 2O3 were 1.0 % of the weight and 2.0 % of the weight (2 No. 3), although micro Vickers hardness was carrying out lifting to 621,635 compared with the glass of No.1, respectively, the amount of lifting was small and it did not reach the degree of hardness of chemically strengthened glass. The addition of Er 2O3 is 5.0. With the glass of No.3 of weight %, Hv is 673 and it turned out that Hv of chemically strengthened glass is exceeded. With the glass of No.5-8 the addition of Er 2O3 was made to increase with 10 - 21 % of the weight furthermore, Hv went up further and was set to 683,707,712 and 722, respectively.

[0041] The micro Vickers hardness to the addition of each oxide is shown in drawing 1 . The addition of an axis of abscissa was displayed by mol % of the oxide containing two cations. Namely, SiO2 As Si 2O4, Er 2O3 and aluminum2O3 were taken as the display by oxide conversion as it is. As shown in drawing 1 , with the glass which added Er 2O3, Hv was going up almost linearly to the addition. 2OEr3 addition — 0.013-mol% (5.0 % of the weight) — it became more than Hv of chemically strengthened glass above.

[0042] although the inclination for Hv to go up on the other hand also in Si 2O4 and the glass (No.8-11) which added aluminum2O3 was seen — the amount of lifting — small — more than 0.05mol% — even if it added, the level of chemically strengthened glass was not reached.

[0043] Change of the coefficient of thermal expansion to the addition of each oxide is shown in drawing 2 . With the glass which added Er 2O3, the coefficient of thermal expansion also rose with lifting of an addition. Since the coefficient of thermal expansion of an information record-medium layer was large, matching with an information record-medium layer was good by lifting of the coefficient of thermal expansion of a substrate.

[0044] As mentioned above, when Er 2O3 was added, Hv was able to be raised greatly. The content of Er 2O3 besides the example shown in a table 1 is 0.5. Most lifting of Hv was not seen under by weight %. Therefore, Er 2O3 is 0.5. It is desirable that it is more than weight %. Moreover, when it was made to contain exceeding 30 % of the weight, the oxide made to contain did not dissolve into glass, but became an ununiformity. As for the content of this to Er 2O3, it is desirable that it is 30 or less % of the weight. Moreover, SiO2 considered to raise other mechanical strengths Although the amount of lifting of Tg was almost comparable when the component and the amount of lifting of Hv and Tg which are called aluminum 2O3 were measured, it was more effective to add Er 2O3 about lifting of Hv. Also in the glass to which 2Oaluminum3 content of No.14-16 was made to increase, Hv improved rather than the glass of No.20-22 which did not make Er 2O3 contain. No. — when 15 or 16 glass was heat-treated at 900 degrees C, the crystal grain child deposited in glass and glass became translucent. When Hv was measured in this condition, compared with 760,720 and heat treatment before, Hv was large, respectively. At No.17-19, it is Na2O. The content was decreased to the amount of the one half of No.1. Therefore, since it was possible that characteristic temperature rises, specified quantity content of B-2s O3, BaO, and SrO which are low melting point-ized components was carried out. In these glass, it is 5.0. Er 2O3 of weight % was made to contain. In any case, compared with the glass of No.23-25 which are not making Er 2O3 contain, Hv improved greatly.

[0045] Next, the three-point bending strength test of chemically strengthened glass (No.12) was performed for the glass of No.1, the glass of No.5, and a comparison. a table 3 — the average (sigma/MPa) of three-point bending reinforcement — it is shown.

[0046]

[A table 3]

表 3

No.	n	σ (MPa)
1	20	328
5	20	391
26	20	390

[0047] Assessment is 0.63mm in glass thickness, width of face of 2mm, and die length of 3mm. It carried out using the test piece. A lower span is 1.2mm. It carried out. The number of test pieces (n) was set to 20 also with each sample. If the added load is set to w, the three-point bending reinforcement sigma (MPa) will become sigma= (3lw/2at2). Here, they are an l; lower span, the width of face of a; test piece, and the thickness of t; test piece. The three-point bending reinforcement of an average of the glass of No.1 was 328MPa(s). It is Er 2O3 10.0 With the glass of No.5 weight % content of was done, reinforcement of average three-point bending reinforcement was improving about 19% with 391, and it had reinforcement equivalent to chemically strengthened glass (No.26).
[0048] in order [next,] to examine the mechanism of the improvement in a mechanical strength by making a rare earth oxide contain — a transmission electron microscope — No.1- the microstructure of the glass of 8 and 10 was observed.
[0049] The glass which reaches and does not contain the rare earth oxide of 10 was a homogeneous amorphous state No.1. On the other hand, with the glass of No.2-8, the detailed particle of nano order deposited in the amorphous glass matrix. Observation of a high-resolution image showed that these particles were crystalline substances. Thus, in the glass containing a rare earth oxide, the particle was observed and the degree of the improvement in a mechanical strength was large. On the other hand with the glass which made the aluminum2O3 grade contain like the glass of No.10, the particle was not observed in glass, but the degree of the improvement in on the strength was also small. From this, it is thought that reinforcement improved by existence of this very fine particle.
[0050] The particle size of this microcrystal particle changed with 2OEr3 contents. The mean particle diameter of the particle produced on each glass and the permeability of the white light are shown in a table 4.
[0051]
[A table 4]

表 4

No.	2	3	4	5	6	7	8
Er_2O_3含有量 (重量比)	1.0	2.0	5.0	10.0	15.0	16.0	21.0
平均粒径(nm)	1	3	8	15	38	51	103
透過率(%)	91	85	79	74	70	67	58

[0052] Moreover, the relation of the mean particle diameter of the microcrystal particle to 2OEr3 addition which deposits, and the permeability of glass is shown in drawing 3 and drawing 4 . Mean particle diameter was rising in proportion to the 2nd [about] power of 2OEr3 addition. Permeability decreased in proportion to negative [of 2OEr3 addition]. Although the permeability of the white light was efficient at 60% or more and record playback was performed when the permeability of light and the effectiveness of optical information record were investigated, record playback with a well head was not able to be performed at less than 60%. Therefore, as for the permeability of the white light, it is desirable that it is 60% or more. The mean particle diameter of the glass of No.16 was 51nm, and the rate of the volume of the particle calculated from a TEM photograph was 22%. From these things, if mean particle diameter exceeds 50nm, the rate of the volume of a particle will increase and the permeability of the white light will decrease. For this reason, it is not desirable, if 2OEr3 content exceeds 16 % of the weight, the mean particle diameter of a deposit particle exceeds 50nm and the rate of the volume of a deposit particle exceeds 20% further.
[0053] Next, it inquired by making the glass of No.1 contain various rare earth elements. The class of added rare earth elements and the glass transition temperature (Tg) of the obtained glass, a coefficient of thermal expansion, and micro Vickers hardness (Hv) are shown in a table 5. The relation between Hv and Tg in the rare earth elements added to drawing 5 and drawing 6 is shown. The oxide of Ln 2O3 performed addition. The addition was made into 0.026-mol% also with each oxide. The production approach of glass and the measuring method of a property are the same as that of a table 1.
[0054]
[A table 5]

表 5

No.	Ln	Ln_2O_3 含有量 (重量比)	Tg (℃)	α	Hv
27	Sc	3.58	593	91.4	666
28	Y	5.89	582	81.6	653
29	La	8.47	583	90.2	650
30	Ce	8.53	582	91.3	648
31	Pr	8.61	585	92.2	651
32	Nd	8.78	587	86.4	646
33	Sm	9.07	584	93.5	651
34	Eu	9.19	585	95.5	652
35	Gd	9.46	580	90.9	685
36	Tb	9.51	583	90.3	682
37	Dy	9.70	581	90.6	683
38	Ho	9.82	584	91.6	682
39	Er	10.00	582	92.2	683
40	Tm	10.03	586	92.0	682
41	Yb	10.30	588	90.9	685
42	Lu	10.40	585	91.1	684

[0055] It was going up, even when micro Vickers hardness was seen, and which rare earth elements were added. When the amount of lifting was seen, the direction at the time of adding the so-called heavy-rare-earth element by the side of a heavy element from Gd 2O3 was large. The value of those degrees of hardness was 680 or more, and was larger than Hv of chemically strengthened glass. On the other hand, in the case where the light-rare-earth element from Sc 2O3 to Eu 2O3 is added, it was less from the level of chemically strengthened glass 650 order.
[0056] In the case of every element, glass transition temperature was fixed at about 585 degrees C. The range of a coefficient of thermal expansion was 81.6 - 92.2x10-7/degree C, and matching with an information record-medium layer was good. As a class of rare earth elements to add, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu are more desirable than the above examination.
[0057] When the structure of glass of No.21 containing Gd 2O3 was observed by TEM, the same microcrystal particle as the glass which added Er 2O3 was observed. Mean particle diameter was 15nm.
[0058] Next, the presentation of mother glass was considered. SiO2 At less than 40 % of the weight, since a mechanical strength and chemical stability were spoiled, a content was not desirable. Moreover, SiO2 When the content exceeded 80 % of the weight, melting nature fell and many striae occurred. Moreover, the coefficient of thermal expansion became small too much, and was unsuitable as glass for substrates. As mentioned above, SiO2 As for a content, it is desirable that it is 40 % of the weight - 80 % of the weight.
[0059] When **** glass was made to contain B-2 O3, it excelled in the fluidity and the glass of a proper coefficient of thermal expansion was obtained. However, when the content exceeded 20 % of the weight, the effectiveness of the improvement in a mechanical strength by rare earth content became small. For this reason, as for the content of B-2 O3, it is desirable that it is 20 or less % of the weight.
[0060] Next, the alkali-metal oxide was examined. When the sum total of the content of an alkali-metal oxide (Li2O, Na2O, K2O) exceeded 20 % of the weight, chemical stability fell. As for the sum total of the content of this to an alkali-metal oxide, it is desirable that it is 0 - 20 % of the weight. Furthermore, when it exceeded 20 % of the weight similarly about the alkaline-earth-metal oxide, chemical stability fell. As for the sum total of the content of this to an alkaline-earth-metal oxide, it is desirable that it is 0 - 20 % of the weight.
[0061] Although the same effectiveness was seen in the semantics which makes glass form into the low melting point, the total quantity of the fluidity was bad at less than 10 % of the weight, and the stria generated many alkali-metal oxides, alkaline-earth-metal oxides, and B-2s O3. Moreover, when it exceeded 30 % of the weight, chemical stability fell. As for the sum total of the content of the alkali-metal oxide from this, an alkaline-earth-metal oxide, and B-2 O3, it is desirable that it is 10 - 30 % of the weight.
[0062] Moreover, although it was effective for making the mechanical strength and chemical stability of glass increase, the fluidity of glass fell and aluminum 2O3 was not desirable, when the content exceeded 17 % of the weight. Therefore, as for the content of aluminum 2O3, it is desirable that it is 17 or less % of the weight.
[0063] Moreover, since raw material powder remained in glass at the time of the glass dissolution if it exceeds 30 % of the weight, it was difficult for the content of a rare earth oxide to obtain uniform glass, and it was not desirable. The effectiveness of improvement in a mechanical strength was acquired by addition of such a little rare earth oxide that there is little sum total of the content of an alkali-metal oxide. When the total quantity of an alkali-metal oxide and an alkaline-earth-metal oxide was 10 % of the weight, improvement in a mechanical strength was found for the addition of a rare earth oxide even at least 0.5% of the weight. However, 0.5 The effectiveness of the improvement in a mechanical strength was small at under weight %. Therefore, as for the content of a rare earth oxide, it is desirable that it is 0.5 - 30 % of the weight.
[0064] The glass substrate of this invention has obtained sufficient reinforcement by having added rare earth elements. Therefore, with the conventional glass substrate, the required chemical strengthening can be performed as it is unnecessary. That is, it is characterized by there being no compression consolidation layer which made the glass front face produce residual stress. The existence of a surface compression consolidation layer irradiates a laser beam from a front face, and can be measured by the approach of carrying out the spectrum of the reflected light using prism. When the glass substrate of this invention was measured

by the above-mentioned approach, there is almost no residual-stress difference in the interior of a glass substrate and a front face, namely, it was checked that there is no surface stress layer.
[0065] Next, the actual substrate was produced using the glass of an example and the property was evaluated. The glass of No.1, and 5, 7, 8, 18 and 35 was used for glass. Moreover, the chemically-strengthened-glass substrate of No.26 and the SiO2-aluminum2O3-ZnO-MgO-RO system glass-ceramics substrate shown in a table 6 were evaluated as an example of a comparison.
[0066]
[A table 6]

表 6

No.	Tg (℃)	α	Hv	備考
43	780	114	720	結晶化ガラス

[0067] The produced glass substrate is 65mmphi and 0.635mmt. It carried out. The permeability of the water resisting property of the obtained substrate, thermal resistance, surface roughness, and the white light is shown in a table 7.
[0068]
[A table 7]

表 7

No.	耐水性 アルカリ濃度(ppm)	耐熱性	表面粗さ Ra(A)	透過率 (%)
5	10.0	○	4	74.0
35	15.0	○	4	94.0
26	312.0	△	4	95.0
43	2.0	○	9	15.0
1	11.0	○	4	94.0
7	11.5	○	5	67.0
8	10.7	○	10	58.0
18	4.0	○	5	79.0

[0069] A water resisting property is immersed in 80ml of 70-degree C hot pure water in a substrate for 20 hours, detects the total alkali and the amount of alkaline earth elements which were eluted the inside of pure, and is ppm about a total elution volume. It displayed. Thermal resistance heated the substrate at 350 degrees C among the vacuum, and carried out secondary ion mass spectroscopy of the surface section after that. What diffusion of alkali ion was regarded as by the surface layer was displayed by **, and what was not seen was displayed by O. Average surface roughness Ra (A) estimated surface roughness using the surface roughness meter. Moreover, permeability irradiated the source substrate front face of the white light, and it asked for it by the intensity ratio of incident light and the transmitted light.
[0070] When the water resisting property was seen, there were few amounts of elution alkali and it was good at No.1, and 5, 7, 8, 18, 35 and 43. In the chemically strengthened glass of No.26, there were many elution volumes of alkali and they were not able to say it as fitness.
[0071] In the heat resistance test, it turned out similarly with the chemically-strengthened-glass substrate of No.26 that many alkali elements were detected by the surface layer and migration of ion has taken place. As mentioned above, in the glass substrate which carried out the chemical strengthening, it was easy to produce migration of an alkali element, and thermal and chemical stability was good in the glass substrate of this invention to having been unstable.
[0072] Next, when surface roughness was seen, in the glass substrate of No.1, and 7, 18, 5, 35 and 26, Ra=4-5A and good smooth nature were obtained. on the other hand -- No. -- with 8 or 43 glass, it became Ra=9-10A and a big value.
[0073] The permeability of the white light was as good as 67 - 95% at No.1, and 7, 5, 18, 35 and 26. No. -- with 8 or 43 glass, permeability was as low as 58 or 15%.
[0074] It investigated about the relation of the deposit condition of surface roughness and a particle. With the glass of No.7, the content of Er 2O3 was 16 % of the weight, and the mean particle diameter of the particle which deposits was 51nm. Moreover, the rate of the volume of a particle was 40%. At this time, permeability was 67%. On the other hand, with the glass of No.8, the content of Er 2O3 was 21 % of the weight, the mean particle diameter of the particle which deposits was 103nm, and the rate of the volume of a particle was 72%. Moreover, permeability was 58%. At this time, surface roughness is 10.0A at the glass of 5.0A and No.8 with the glass of No.7. 2 double front face was coarse. Thus, it turned out that 2OEr3 content exceeds 20 % of the weight, and mean particle diameter exceeds 100nm, surface roughness is coarse and permeability is inferior to smooth nature in it at less than 60%.
[0075] As for the content of the rare earth oxide of the above thing to Er2O3 grade, it is desirable that it is 20 or less % of the weight. As for mean particle diameter, it is still more desirable that it is 100nm or less. Moreover, as for permeability, it is desirable that it is 60% or more. If the above conditions are fulfilled, smooth nature small enough can be obtained.
[0076] The magnetic film was formed in the eight above-mentioned kinds of glass substrates, the magnetic disk was produced, and the property was evaluated. The film configuration of the produced magnetic disk is shown in drawing 8 . drawing 8 -- setting -- 1 -- for Cr substrate film and 4, as for C protective coat and 6, a CoCr system magnetic film and 5 are [a glass substrate and 2 / Cr precoat film and 3 / an etching texture and 7] lubricating film.
[0077] 50nm and 50nm of CoCr system magnetic films were formed [Cr precoat film] for 25nm and Cr substrate film after washing

the magnetic glass substrate of 65mmphi. The etching texture was given for the carbon protective coat after 10nm formation. After tape cleaning, lubricating film 7 was applied and it considered as the magnetic disk. In addition, membrane formation was given to substrate both sides. Then, the existence of the pervasion situation by the alkali of the magnetic film of a magnetic disk and film peeling was evaluated. The magnetic disk drive was produced using this magnetic disk. The schematic diagram of the magnetic disk drive produced to drawing 10 is shown. For a revolving shaft and 10, as for the magnetic head and 12, in drawing 10 , a spindle motor and 11 are [the magnetic disk which showed 8 to drawing 8 , and 9 / a magnetic-head revolving shaft and 13] the output terminals of an electric system. The revolving shaft 9 was equipped with the magnetic disk 8 of six sheets in equipment. The magnetic head 11 was allotted to each two substrate both sides. The control system etc. was connected and it considered as the magnetic disk drive. The head flying height under magnetic-disk revolution could be 40nm.
[0078] Record reproducing characteristics were evaluated using this magnetic disk drive. An alkali pervasion situation, film peeling, and record reproducing characteristics are shown in a table 8.
[0079]
[A table 8]

表 8

No.	アルカリ侵食	膜剥がれ	記録再生特性
5	O	O	O
21	O	O	O
12	Δ	Δ	O
29	O	O	Δ

[0080] The alkali pervasion situation made ** O and 5% or more of case, when the percentage of a magnetic disk that pervasion was seen among the obtained magnetic disks was less than 5%. Film peeling was evaluated similarly. Record reproducing characteristics displayed the good thing by O, and displayed the not good thing by **. The magnetic disk of this invention had little alkali pervasion and film peeling, and its record reproducing characteristics were also good. In the chemically strengthened glass of No.12, alkali pervasion and film peeling were seen notably, and it was not desirable. Moreover, although alkali pervasion, film peeling, etc. were not seen, its record reproducing characteristics were not good at glass-ceramics No.29. Next, the glass substrate was produced using various glass of this invention, and the shock-proof trial was performed. The shock-proof trial formed the magnetic film, the protective coat, etc., produced the magnetic disk of the membrane structure shown in drawing 8 , and evaluated it by the process same to both sides of a glass substrate as the above-mentioned using this disk. The test method fixed the produced disk to the fixture, and performed it by making a dummy head collide with a disk with an accelerator. this trial — one kind of magnetic disk — receiving — 30 points — carrying out — a crack — applying — etc. — the frequency of the point out of which the defect came estimated. No.1-5 of a table 1 and the glass of 14, 18, 23, 24, 25, 26, and 43 were used for the glass for substrates. A test result is shown in drawing 7 . The defect frequency [according / an axis of ordinate / to an exam] according [an axis of abscissa] to Hv of each glass was displayed by %. By the degree of hardness not more than it, the defect was seen for the degree of hardness of glass bordering on 670, and the amount rose as the degree of hardness fell. Moreover, the defect in an exam was not seen or more by 670. With [a glass substrate degree of hardness] 670 [or more], from the above thing, the magnetic disk which can be equal to a shock-proof trial is producible.
[0081] The optical disk and the optical disk unit were produced similarly. When the glass substrate of this invention was used, there was also almost no film peeling of a record-medium layer, and it was efficient and record playback was able to be carried out.
[0082] As mentioned above, the information record disk of this invention was excellent in chemical stability, and there were also few defects, such as film peeling. Moreover, the record reproducing characteristics of an information record disk unit were also good. Since neither chemical-strengthening processing nor crystallization processing was furthermore performed to a glass substrate, a disk and equipment were producible to low cost.
[0083] (Example 2) The magnetic disk of the configuration shown in drawing 9 using the glass substrate of this invention was produced. Thickness of a substrate was set to 0.38mm. Moreover, the glass of No.5 which have not carried out chemical-strengthening processing was used for glass. Moreover, the precoat film usually given was not formed but the direct magnetic thin film was formed on the glass substrate. the surface roughness of a glass substrate — Ra=4.0A it was . The magnetic disk which used as the substrate the soda lime glass which performed alkali consolidation processing as an example of a comparison, the usual soda lime glass which has not performed alkali consolidation processing, and crystallization glass was also produced.
[0084] The caustic embrittlement of reinforcement, smooth nature, and a magnetic film and the assessment result about magnetic properties are shown in a table 9. ** estimated what cannot say a property for a good thing with O and fitness.
[0085]
[A table 9]

表 9

基 板	強度	平滑性	磁性膜のアルカリ腐食	磁気特性	備 考
No. 5ガラス	○	○	○	○	実施例
化学強化ソーダライムガラス	○	○	△	△	比較例
化学強化なしソーダライムガラス	△	○	○	○	比較例
結晶化ガラス	○	△	○	△	比較例

[0086] With the magnetic disk of this invention, reinforcement is high and it is 0.380mm. Reinforcement sufficient also by thinness was obtained. Moreover, smooth nature was also good. Even if the corrosion of a magnetic film was not seen, either and it did not form the precoat film, a magnetic film did not deteriorate. Moreover, since smooth nature was good, the flying height of the magnetic head could also be set to 30nm or less, and magnetic properties were also good.
[0087] With the soda lime glass which carried out chemical-strengthening processing, as a result of the alkali component of glass eating a magnetic film away since there is no precoat film although the high mechanical strength was obtained, many things in which the alkali component has adhered to the floatation side of the magnetic head after a system sliding trial were seen. Moreover, that in which the magnetic film has exfoliated after sliding was also seen. On the whole also in the magnetic disk with which a defect was not seen, magnetic properties were falling. The magnetic disk of reinforcement using the soda lime glass which has not carried out a chemical strengthening was inadequate. In glass ceramics, surface roughness was large, since smooth nature was not good, the flying height of the magnetic head was large, and sufficient magnetic properties were not acquired.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Change of the micro Vickers hardness to Er 2O3, aluminum2O3, and 2OSi4 addition.
[Drawing 2] Change of the coefficient of thermal expansion to Er 2O3, aluminum2O3, and 2OSi4 addition.
[Drawing 3] Change of the mean particle diameter of the microcrystal particle to 2OEr3 addition which deposited.
[Drawing 4] Change of the permeability of the white light over 2OEr3 addition.
[Drawing 5] Change of the micro Vickers hardness when adding each rare earth oxide.
[Drawing 6] Change of the glass transition temperature when adding each rare earth oxide.
[Drawing 7] Relation between a substrate degree of hardness (Hv) and a percent defective.
[Drawing 8] The film block diagram of the magnetic-disk substrate produced by this invention.
[Drawing 9] The film block diagram of the magnetic-disk substrate produced in the another example of this invention.
[Drawing 10] The schematic diagram of the magnetic disk drive produced by this invention.
[Description of Notations]
1 [— A magnetic film, 5 / — A protective coat, 6 / — An etching texture, 7 / — Lubricating film, 8 / — A magnetic disk, 9 / — A revolving shaft, 10 / — A spindle motor, 11 / — The magnetic head, 12 / — A magnetic-head revolving shaft, 13 / — Output terminal of an electric system.] — A glass substrate, 2 — The precoat film, 3 — The substrate film, 4

[Translation done.]

* NOTICES *

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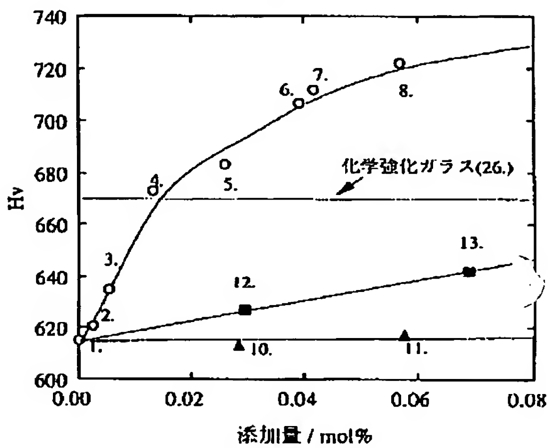
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

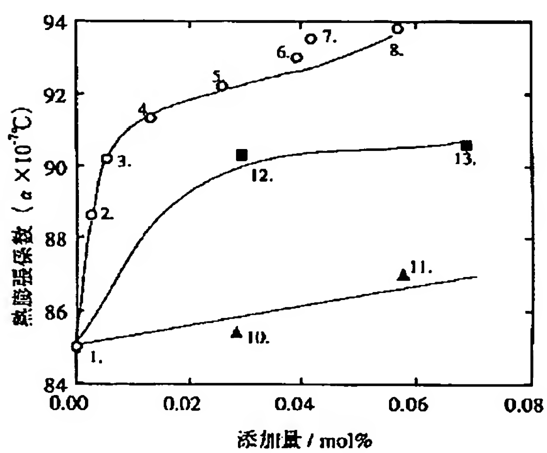
[Drawing 1]

図 1



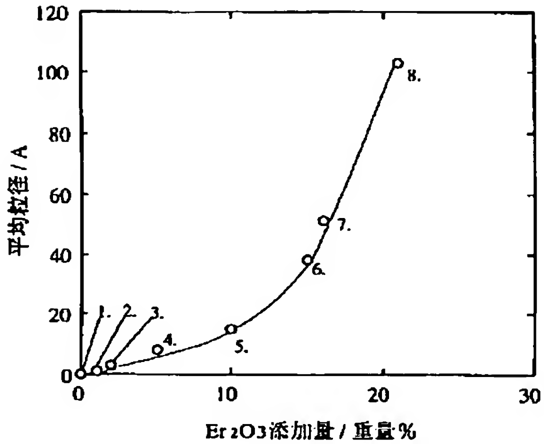
[Drawing 2]

図 2



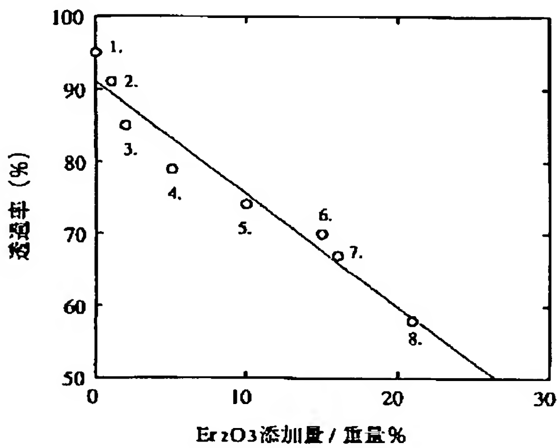
[Drawing 3]

図 3



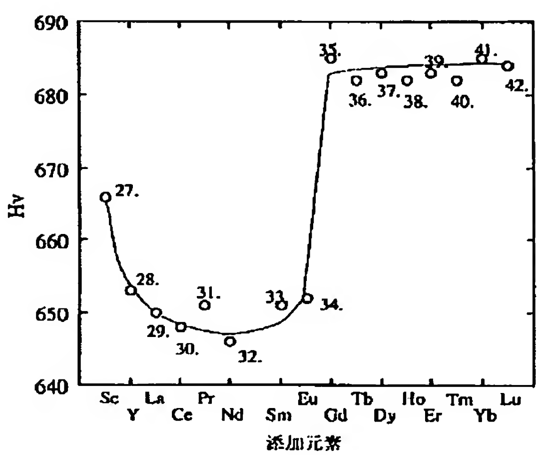
[Drawing 4]

図 4



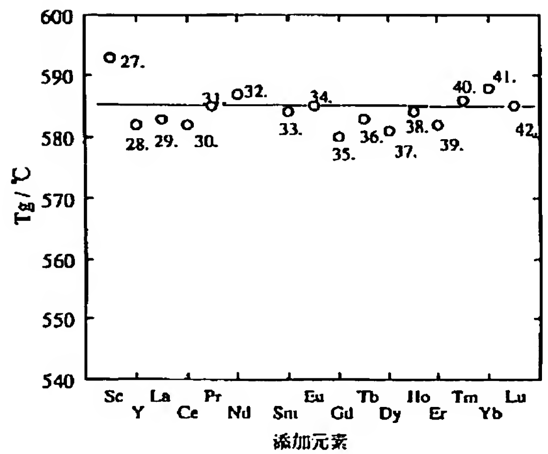
[Drawing 5]

図 5



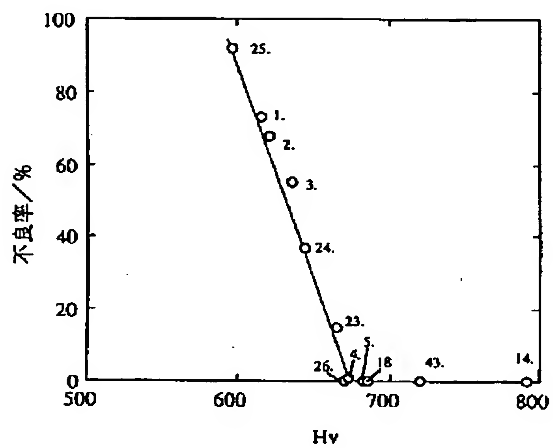
[Drawing 6]

図 6



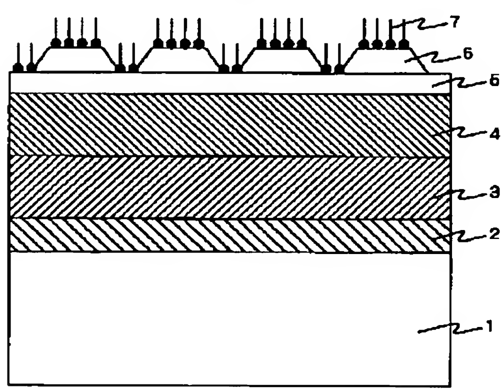
[Drawing 7]

図 7



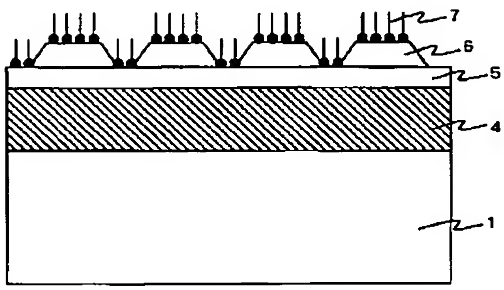
[Drawing 8]

図 8



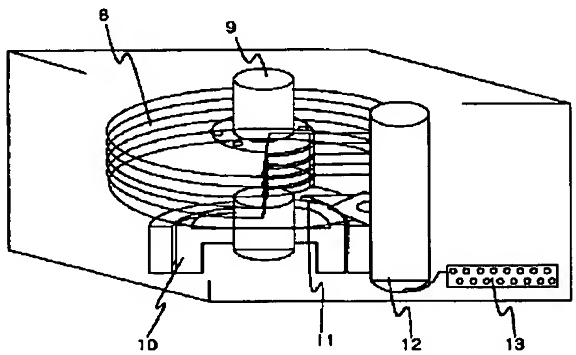
[Drawing 9]

図 9



[Drawing 10]

図 10



[Translation done.]

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[Document to be Amended] Description
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] It is the glass substrate for information record disks with which the layer for recording information is prepared in surface [at least / a part of],
The glass substrate for information record disks characterized by said substrate consisting of glass containing at least one sort of rare earth elements chosen from the group of Sc, Y, La, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.
[Claim 2] The glass substrate for information record disks characterized by for the very fine particle distributing on said glass according to claim 1, and containing said rare earth elements in this very fine particle.
[Claim 3] Said rare earth elements according to claim 1 are glass substrates for information record disks which are oxide conversion of Ln 2O3 (Ln is rare earth elements), and are characterized by containing 0.5 to 30% of the weight to the whole glass.

[Translation done.]

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(33)優先権主張国　日本（ＪＰ）

(71)出願人　０００００５１０８
株式会社日立製作所
東京都千代田区神田駿河台四丁目６番地

(72)発明者　山本　浩貴
茨城県日立市大みか町七丁目１番１号　株式会社日立製作所日立研究所内

(72)発明者　内藤　孝
茨城県日立市大みか町七丁目１番１号　株式会社日立製作所日立研究所内

(72)発明者　滑川　孝
茨城県日立市大みか町七丁目１番１号　株式会社日立製作所日立研究所内

(74)代理人　弁理士　小川　勝男

最終頁に続く

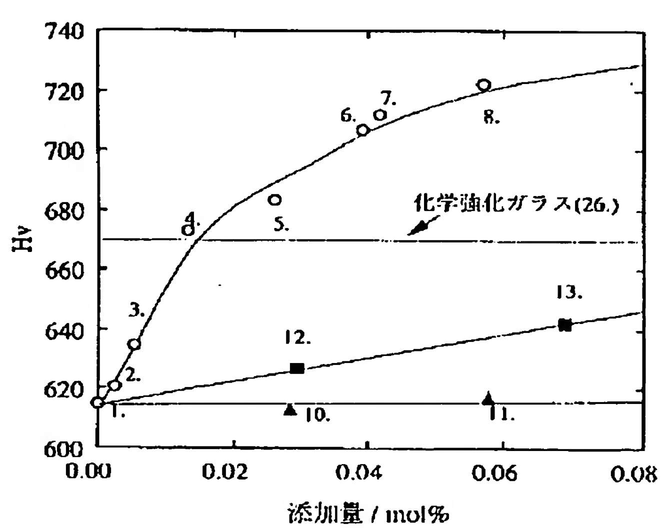
(54)【発明の名称】情報記録ディスク用ガラス基板

(57)【要約】

【課題】高い機械的特性を有し、かつ化学的安定性，熱的安定性，平滑性及び透明性に優れた情報記録ディスク用ガラス基板を提供する。

【解決手段】表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、前記基板がＳｃ，Ｙ，Ｌａ，Ｐｒ，Ｎｄ，Ｐｍ，Ｓｍ，Ｅｕ，Ｇｄ，Ｔｂ，Ｄｙ，Ｈｏ，Ｅｒ，Ｔｍ，Ｙｂ，Ｌｕの群から選ばれた少なくとも１種の希土類元素を含有するガラスからなることを特徴とする情報記録ディスク用ガラス基板。

図　１



【特許請求の範囲】

【請求項１】表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、

前記基板がＳｃ，Ｙ，Ｌａ，Ｐｒ，Ｎｄ，Ｐｍ，Ｓｍ，Ｅｕ，Ｇｄ，Ｔｂ，Ｄｙ，Ｈｏ，Ｅｒ，Ｔｍ，Ｙｂ，Ｌｕの群から選ばれた少なくとも１種の希土類元素を含有するガラスからなることを特徴とする情報記録ディスク用ガラス基板。

【請求項２】請求項１記載のガラス基板の表面部の圧縮強化層が存在せず、ガラス基板内部の応力分布が実質的に均一であることを特徴とする情報記録ディスク用ガラス基板。

【請求項３】請求項１記載の前記ガラスに微細粒子が分散しており、かつ該微細粒子中に前記希土類元素が含まれていることを特徴とする情報記録ディスク用ガラス基板。

【請求項４】請求項１記載の前記希土類元素はLn_2O_3（Ｌｎは希土類元素）の酸化物換算で、ガラス全体に対して０．５ ～３０重量％含有することを特徴とする情報記録ディスク用ガラス基板。

【請求項５】請求項１記載の前記希土類元素はLn_2O_3（Ｌｎは希土類元素）の酸化物換算で、ガラス全体に対して０．５ ～２０重量％含有することを特徴とする情報記録ディスク用ガラス基板。

【請求項６】請求項１記載の希土類元素がＧｄ，Ｔｂ，Ｄｙ，Ｈｏ，Ｅｒ，Ｔｍ，Ｙｂ、及びＬｕの中から選ばれた少なくとも１種以上であることを特徴とする情報記録ディスク用ガラス基板。

【請求項７】請求項３記載の微細粒子の平均粒径が１～１００ｎｍであることを特徴とする情報記録ディスク用ガラス基板。

【請求項８】請求項３記載の微細粒子がガラス全体に対して、体積率で１％以上，４０％以下であることを特徴とする情報記録ディスク用ガラス基板。

【請求項９】請求項１記載の前記希土類元素はLn_2O_3（Ｌｎは希土類元素）の酸化物換算で、ガラス全体に対して０．５ ～２０重量％含有し、他の成分としてSiO_2：４０～８０重量％，B_2O_3：０～２０重量％，R_2O（Ｒはアルカリ金属）：０～２０重量％，ＲＯ（Ｒはアルカリ土類金属）：０～２０重量％，Al_2O_3：０～１７重量％を含み、かつR_2O ＋ＲＯ：１０～３０重量％であることを特徴とする情報記録ディスク用ガラス基板。

【請求項１０】請求項１において、前記ガラスの可視白色光の透過率が６０％以上であることを特徴とする情報記録ディスク用ガラス基板。

【請求項１１】表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、

前記基板の硬度がＨｖ６７０以上であり、かつ可視白色光の透過率が６０％以上、かつガラス基板の表面部の圧縮強化層が存在せず、ガラス基板内部の応力分布が実質的に均一であることを特徴とする情報記録ディスク用ガラス基板。

【請求項１２】表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、

前記基板の厚さが０．３８㎜ 以下であり、かつ基板表面の粗さがＲａで５ｎｍ以下、かつガラス基板の表面部の圧縮強化層が存在せず、ガラス基板内部の応力分布が実質的に均一であることを特徴とする情報記録ディスク用ガラス基板。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は情報記録ディスク用ガラス基板に係り、特に高強度で化学的安定性，熱的安定性，平滑性に優れた固定型磁気ディスク記録装置用の磁気ディスク用ガラス基板，光磁気ディスク装置用の光磁気ディスク用ガラス基板，結晶の相変態を利用した光ディスク，ＤＶＤ（ディジタル・ビデオ・ディスク）等のディスク用ガラス基板に関する。

【０００２】

【従来の技術】大型コンピューターやパーソナルコンピューターの情報記録装置として、現在、磁気ディスク装置，光磁気ディスク装置が主流となっている。これら情報記録装置は、装置の小型軽量化，情報読み書き速度の高速化に伴い、情報記録密度が年々増加している。例えば、磁気ディスク装置においては、数年前のディスク基板の直径は８．８インチが標準であったが、近年では３．５，２．５，１．８，インチ等の小型磁気ディスク基板が開発されている。また、ディスク径の縮小のみならず、ディスク基板厚さも０．６３㎜ 以下と薄くなっている。従って、従来にも増して高強度な基板が求められている。また、ヘッドと媒体との浮上量が小さくなってきており、この浮上量を制御できる基板の平滑性が求められている。

【０００３】従来の磁気ディスク用基板には、アルミニウム合金が用いられていた。しかし、アルミニウム合金は変形しやすく、さらに硬さが不十分なため、研磨後のディスク表面の平滑性が十分とは言えないという問題があった。また、ヘッドが機械的に磁気ディスクに接触する際、磁気記録媒体層が剥離しやすいという問題があった。そのため、変形が少なく、平滑性が良好で、かつ機械的強度の大きいガラス基板の開発が進められている。このガラス基板は、基板自体に透光性が要求される光磁気ディスク，光ディスク用の基板としても用いることができるため、以下情報記録ディスク用ガラス基板と総称する。

【０００４】現在、上記情報記録ディスク用ガラス基板

は、基板表面のアルカリ元素を他のアルカリ元素と置換することにより機械的強度を向上させた化学強化ガラス，非晶質のガラス中に微細な結晶質粒子を析出させた結晶化ガラスが開発されている。しかし、化学強化ガラスでは、表面にアルカリ置換層が存在するために基板洗浄時にアルカリイオンが磁性膜成膜の際の加熱工程時に表面に移動して溶出したり、磁性膜を侵食したり、膜の付着強度を劣化させたりする懸念があった。このため、特開平7－223845 号公報では、化学強化後、さらに化学処理を施すことによって化学的耐久性に優れた化学強化ガラスを得ている。

【０００５】一方、結晶化ガラスでは、生じる微結晶粒子と非晶質ガラスとの摩耗性の違いから、表面研磨後の凹凸が大きく平滑性が十分とは言えなかった。そのため、ヘッドの浮上量の低下に対応するのが難しかった。特開平7－300340 号公報では、結晶粒子の粒径を５～１００ｎｍと微細化することにより平滑性を向上させている。

【０００６】

【発明が解決しようとする課題】しかし、特開平7－223845 号公報の化学強化技術でも、化学強化処理工程における化学強化及び研磨プロセス後の基板の特性を均質にするのが依然として難しいという問題がある。さらに、アルカリイオンが磁性膜を侵食する問題が完全に解決されないため、磁性膜とガラス基板の間にアルカリイオンの拡散を防止する中間膜を設ける必要がある。また、特開平7－300340 号公報の結晶化ガラス技術では、基板が乳白色に着色するため透光性が低く、光を用いた情報記録媒体用の基板への適用が困難である。また、高精度な結晶化プロセスが要求されるため、基板の特性を均質にするのが難しいという問題がある。

【０００７】また、上記いずれの方法を用いた場合でも、化学強化処理工程，結晶化工程といった後処理プロセスが必要なため、低コスト化が難しい。

【０００８】本発明の目的は、十分な機械的強度，化学的安定性，光透過性を有し、かつ短時間のプロセスで製造可能な情報記録ディスク用ガラス基板を提供することにある。

【０００９】

【課題を解決するための手段】上記目的を達成するため、本発明の第１の発明によれば、表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、前記基板が希土類元素を含有するガラスからなることを特徴とする情報記録ディスク用ガラス基板が提供される。

【００１０】上記情報を記録するための層とは、基板の表面に直接、または間接的に設けられた磁性媒体層，光の照射により相変態を起こす物質の層、あるいは光の反射率の異なる物質または機械的な段差等を設けることにより情報を記録している物質の層など、情報が記録され、また、その情報を読み出すことができる層であれば、どのようなものであっても、本発明が適用できる。上記情報を記録するための層を表面に間接的に設けるとは、中間膜（プリコート膜）等を、情報を記録するための層とガラス基板の間に設けることである。例えば、接着強度の向上を図ったり、化学的な反応を抑制するなどの目的を付加するための構成であっても、本発明が適用できる。

【００１１】表面の少なくとも一部とは、ディスク円板面の両面、または片面でも良いし、さらには同一面でも外周側，内周側のみに情報を記録するための層が設けられているような場合でも良いということである。

【００１２】上記構成により、十分な機械的強度，化学的安定性，光透過性を有し、かつ短時間のプロセスで製造可能な情報記録ディスク用ガラス基板を提供することができる。

【００１３】第１の発明において、前記ガラスに微細粒子が分散しており、かつ該微細粒子中に前記希土類元素が含まれていることが好ましい。

【００１４】網目構造を有するガラス組織中に溶け込むことのできる希土類元素の量には上限（固溶限）があり、上限を超える量の希土類元素が添加されると結晶相、または非晶質相としてガラス母相中に析出する。このような結晶相、または非晶質相からなる粒子を微細粒子と称している。希土類元素の分布が不均一の場合は、部分的に固溶限を超えて微細粒子が析出する場合もあるため、必ずしも希土類元素の含有量が、母相ガラスの固溶限を超えている必要はない。希土類元素は、ガラス母相中と、微細粒子のどちらにも存在することが好ましい。また、微細粒子は、結晶質であることが好ましい。結晶質かどうかは、たとえば透過型電子顕微鏡写真で格子像を観察すると、結晶質の部分は格子縞が観察されるのに対し、ガラス質（非晶質）の部分には格子縞が観察されないことから容易に判断できる。

【００１５】微細粒子がガラス母相中に分散していることにより、応力を受けた際にも粒子がガラス母相の変形，破壊を抑制する作用をするため、ガラスの強度がより向上する。この場合、分散している粒子は、微細かつ均一に分散している方が、強度向上効果が高い。

【００１６】また、第１の発明において、前記希土類元素はLn_2O_3（Ｌｎは希土類元素）の酸化物換算で、ガラス全体に対して０．５ ～３０重量％含有することが好ましい。更に、希土類元素を０．５ ～２０重量％とすることが好ましい。希土類元素の含有量が０．５ 重量％未満では機械的強度の向上効果が小さい。３０重量％を超えるとガラス溶解時に希土類元素酸化物の原料粉末が残存し、均一なガラスを得ることが難しい。また、希土類元素の含有量がを超えると微細粒子の粒径が大きくなり、基板の表面粗さが大きくなる。

【００１７】磁気ヘッドの浮上量がより小さく、高記録

密度の磁気ディスク装置に対しては、希土類元素の含有量を２０重量％以下にすることが望ましい。

【００１８】第１の発明において、希土類元素がＧｄ，Ｔｂ，Ｄｙ，Ｈｏ，Ｅｒ，Ｔｍ，Ｙｂ、及びＬｕの中から選ばれた少なくとも１種以上であることが好ましい。希土類元素はイオン半径が大きいため微細粒子としてガラス母相中に析出しやすい。希土類元素の中でも上記元素は、ガラス母相中で最も微細粒子を均一に析出させ易く、強度向上効果が高い。

【００１９】微細粒子の平均粒径は１～１００ｎｍであることが好ましい。

【００２０】平均粒径が１００ｎｍを超えると粒子の体積率が増加し、基板の表面粗さが大きくなる。磁気ヘッドの浮上量がより小さく、高記録密度の磁気ディスク装置に対しては、希土類元素の平均粒径を１００ｎｍ以下とすることが望ましい。また、平均粒径が１ｎｍ以下の場合は強度の向上効果が小さい。

【００２１】上記微細粒子がガラス全体に対して、体積率で４０％以下であることが好ましい。

【００２２】析出粒子の体積率が４０％を超えると基板の表面粗さが大きくなり、上記で述べたように好ましくない。

【００２３】第１の発明において、前記希土類元素はLn_2O_3（Ｌｎは希土類元素）の酸化物換算で、ガラス全体に対して０．５～２０重量％含有し、他の成分としてSiO_2：４０～８０重量％，B_2O_3：０～２０重量％，R_2O（Ｒはアルカリ金属）：０～２０重量％，ＲＯ（Ｒはアルカリ土類金属）：０～２０重量％，Al_2O_3：０～１０重量％を含み、かつR_2OとＲＯの合計量が１０～３０重量％であることが好ましい。上記ガラスの中では、ソーダライムガラスと呼ばれるガラスが母相成分であるとき最もガラス強度の向上が大きい。また、アルカリ元素とアルカリ土類元素が含有されているケイ酸塩ガラスにおいて、特に希土類元素の添加効果が高い。添加した希土類元素の多くは、ガラスマトリックス中に固溶するが、その内のマトリックスに固溶できない一部の希土類元素が結晶質の微細粒子として析出する。希土類元素のマトリックスへの固溶限界、すなわち析出のし易さは、マトリックスの種類により異なる。前述したように微細粒子がある程度析出しないとガラスの強度は十分向上しない。上記組成のアルカリ元素とアルカリ土類元素が含有されているケイ酸塩ガラスをマトリックスとして用いた場合は、希土類元素を適度に析出し易く、また情報記録ディスクに要求される強度，化学的安定性等を満足したガラス基板が製造できる。

【００２４】第１の発明において、前記ガラスの可視白色光の透過率が６０％以上であることが好ましい。光ディスク用のガラス基板として使用するためには、可視白色光の透過率が６０％以上であるように、析出粒子の量，粒径を制御する必要がある。透過率が６０％を下回ると、記録媒体に情報を記録するためのレーザ光がガラス基板中を透過する際に減衰し、Ｓ／Ｎ比等の減少を招く。

【００２５】また、上記目的を達成するため、本発明の第２の発明によれば、表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、前記基板の硬度がＨｖ６７０以上であり、かつ可視白色光の透過率が６０％以上、かつ熱処理を行っても、基板表面にアルカリ元素の濃化が起こらないことを特徴とする情報記録ディスク用ガラス基板が提供される。

【００２６】上記構成により、薄板化が可能で、かつ基板表面の研削後に化学強化が不要な情報記録ディスク用ガラス基板が提供できる。

【００２７】また、本発明の第３の発明によれば、表面の少なくとも一部に、情報を記録するための層が設けられる情報記録ディスク用ガラス基板であって、前記基板の厚さが０．３８㎜以下であり、かつ基板表面の粗さがＲａで５ｎｍ以下、かつ熱処理を行っても、基板表面にアルカリ元素の濃化が起こらないことを特徴とする情報記録ディスク用ガラス基板が提供される。

【００２８】上記構成によれば、薄板化が可能で、かつ基板表面の研削後に化学強化が不要な情報記録ディスク用ガラス基板が提供できる。

【００２９】第３の発明において、情報記録ディスク用ガラス基板の直径が２．５インチ以上であることが好ましい。

【００３０】

【発明の実施の形態】

（実施例１）以下、本発明を実施例を用いて詳細に説明する。

【００３１】表１に本発明で検討したガラスの原料の配合割合（重量比）及びガラス転移温度（Ｔｇ／℃），熱膨張係数（$\alpha\times10^{-7}$／℃），マイクロビッカース硬さ（Ｈｖ）を示す。

【００３２】

【表１】

表1

No.	配合割合（重量比）											Tg (℃)	α	Hv
	SiO_2	CaO	Al_2O_3	MgO	B_2O_3	BaO	SrO	TiO_2	ZnO	Na_2O	Er_2O_3			
1	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	0.0	550	85.0	615
2	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	1.0	560	88.6	621
3	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	2.0	558	90.2	635
4	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	5.0	585	91.3	673
5	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	10.0	582	92.2	683
6	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	15.0	590	93.0	707
7	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	18.0	598	93.5	712
8	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	21.0	608	93.8	722
9	72.5	8.0	1.4	4.1	−	−	−	−	−	14.0	32.0	−	−	−
10	75.9	8.0	1.4	4.1	−	−	−	−	−	14.0	0.0	563	85.4	613
11	79.5	8.0	1.4	4.1	−	−	−	−	−	14.0	0.0	570	87.0	617
12	72.5	8.0	4.4	4.1	−	−	−	−	−	14.0	0.0	572	90.3	627
13	72.5	8.0	8.4	4.1	−	−	−	−	−	14.0	0.0	583	90.6	642
14	67.8	−	14.5	−	−	−	−	−	−	17.7	10.0	530	98.6	792
15	50.0	6.0	16.5	7.0	−	−	−	6.5	14.0	−	10.0	545	110.0	720
16	40.0	10.0	17.0	10.0	−	−	−	7.0	16.0	−	10.0	520	126.5	706
17	72.5	8.0	1.4	4.1	7.0	−	−	−	−	7.0	5.0	584	59.5	721
18	72.5	8.0	1.4	4.1	−	15.2	−	−	−	7.0	5.0	605	76.9	688
19	72.5	8.0	1.4	4.1	−	−	10.3	−	−	7.0	5.0	617	76.0	685
20	67.8	−	14.5	−	−	−	−	−	−	17.7	−	520	95.4	735
21	50.0	6.0	16.5	7.0	−	−	−	6.5	14.0	−	−	521	103.0	652
22	40.0	10.0	17.0	10.0	−	−	−	7.0	16.0	−	−	502	122.4	634
23	72.5	8.0	1.4	4.1	7.0	−	−	−	−	7.0	−	594	57.0	710
24	72.5	8.0	1.4	4.1	−	15.2	−	−	−	7.0	−	588	77.9	644
25	72.5	8.0	1.4	4.1	−	−	10.3	−	−	7.0	−	597	72.0	597

【0033】ガラス転移温度，熱膨張係数は、ガラスの熱膨張曲線から求めた。熱膨張係数は、50℃から500℃までのガラスの伸び率から算出した。昇温速度は5℃／分、測定荷重は10gとした。また参照試料には石英ガラス（熱膨張係数；5×10^{-7}／℃）を用いた。また、試料の形状は、5㎜φ×20㎜Hとした。マイクロビッカース硬さ（Hv）は、測定荷重100g，荷重印加時間15秒の条件で10ヵ所測定し、その平均値とした。

【0034】ガラス作製方法は以下のとおりとした。定められた量の原料粉末を白金製のるつぼに秤量して入れ、混合した後、電気炉中で1600℃で溶解した。原料が十分に溶解した後、白金製の撹拌羽をガラス融液に挿入し、約1時間撹拌した。その後撹拌羽を取り出し、30分静置した後、約300℃に加熱された黒鉛製の治具にガラス融液を流し込んで急冷することによりガラスブロックを得た。その後各ガラスのガラス転移温度付近までブロックを再加熱し、1～2℃／分の冷却速度で徐冷することにより歪とりを行った。

【0035】No.1のガラスは、酸化珪素を主成分とするガラスである。このガラスを基本組成とし、この100重量部に対して希土類酸化物を添加した。表1中、No.2～8は、希土類酸化物の一つである酸化エルビウム（Er_2O_3）を1～21重量％添加したガラスである。No.9は酸化エルビウムを32重量％含有させたガラスであるが、Er_2O_3の原料粉末がガラス溶解時にガラス中に残存し、均一なガラスを得ることが難しかった。No.10，11及び12，13は、No.1のガラス100重量部に対してSiO_2及びAl_2O_3添加量を増加させて作製したガラスである。

【0036】No.14のガラスは、さらにAl_2O_3の含有量を増加させ、Er_2O_3を10重量％添加したガラスである。No.15，16のガラスは、更にAl_2O_3の含有量を増加させるとともに，SiO_2の含有量を減少させた。また、結晶化成分として，ZnO，TiO_2を含有させ、これに10重量％のEr_2O_3を含有させた。No.17のガラスはNa_2O量をNo.1の半分とし、B_2O_3を加え、Er_2O_3を5重量％加えたガラスである。更にNo.18，19のガラスはNa_2O量をNo.1の半分とし、BaO，SrO等のアルカリ土類金属酸化物を添加したガラスである。また、No.20～23のガラスは、それぞれNo.15～19のガラスのEr_2O_3を含有させていないガラスである。

【0037】表2に、比較例として、No.1のガラスをアルカリ置換により化学強化したガラスのTg，α，Hvを示す。

【0038】

【表2】

表2

No.	Tg(℃)	α	Hv	備考
26	557	85	670	化学強化ガラス

【0039】化学強化は、約0.63㎜の平板に加工したガラスを380℃の硝酸カリウム溶液中に40分浸漬して行った。化学強化層の厚みは、約20μmであった。化学強化ガラスのHvは670であった。化学強化前のガラスのHvが615であったことから、化学強化によりHvは約9％上昇していることが分かった。また

化学強化により熱膨張係数は変化しなかった。また、ガラス転移温度は、若干上昇した。

【0040】この化学強化ガラスのHvの結果をもとに、表1に示したガラスの強度を評価する。Er_2O_3の添加量が1.0重量％及び2.0重量％のとき（No.2，3）、マイクロビッカース硬度はそれぞれ621，635と、No.1のガラスに比べて上昇はしていたが、その上昇量が小さく、化学強化ガラスの硬度に達しなかった。Er_2O_3の添加量が5.0 重量％のNo.3のガラスでは、Hvが673であり、化学強化ガラスのHvを超えることが分かった。さらにEr_2O_3の添加量を10～21重量％と増加させたNo.5～8のガラスでは、Hvはさらに上昇し、それぞれ683，707，712及び722となった。

【0041】図1に、各酸化物の添加量に対するマイクロビッカース硬さを示す。横軸の添加量は、陽イオン2個を含む酸化物のモル％で表示した。すなわち、SiO_2は、Si_2O_4として、Er_2O_3とAl_2O_3はそのままの酸化物換算での表示とした。図1に示すように、Er_2O_3を添加したガラスでは、その添加量に対してほぼ直線的にHvが上昇していた。Er_2O_3添加量が0.013mol％(5.0重量％)以上で化学強化ガラスのHv以上となった。

【0042】一方、Si_2O_4，Al_2O_3を添加したガラス（No.8～11）においてもHvが上昇する傾向がみられたが、その上昇量は小さく、0.05mol％以上添加しても化学強化ガラスの水準には達しなかった。

【0043】図2に、各酸化物の添加量に対する熱膨張係数の変化を示す。Er_2O_3を添加したガラスでは、添加量の上昇とともに熱膨張係数も上昇した。情報記録媒体層の熱膨張係数が大きいため、基板の熱膨張係数の上昇により、情報記録媒体層とのマッチングは良好であった。

【0044】以上のように、Er_2O_3を添加した場合、大きくHvを上昇させることができた。表1に示した実施例の他、Er_2O_3の含有量が0.5 重量％未満ではHvの上昇はほとんど見られなかった。従って、Er_2O_3は、0.5 重量％以上であることが好ましい。また、30重量％を超えて含有させると含有させた酸化物がガラス中に溶解せず、不均一となった。このことからEr_2O_3の含有量は30重量％以下であることが好ましい。また他の機械的強度を向上させると考えられるSiO_2やAl_2O_3といった成分とHvとTgの上昇量を比較すると、Tgの上昇量はほぼ同程度であったが、Hvの上昇に関しては、Er_2O_3を添加した方が効果的であった。No.14～16のAl_2O_3含有量を増加させたガラスにおいても、Er_2O_3を含有させなかったNo.20～22のガラスよりもHvが向上した。No.15，16のガラスを900℃で熱処理すると、ガラス内に結晶粒子が析出し、ガラスは半透明になった。この状態でHvを測定すると、それぞれ760，720と熱処理前に比べてHvが大きくなっていた。No.17～19では、Na_2O の含有量をNo.1の半分の量まで減少させた。そのため、特性温度が上昇することが考えられるので、低融点化成分であるB_2O_3，BaO，SrOを所定量含有させた。これらのガラスには、5.0 重量％のEr_2O_3を含有させた。いずれの場合でも、Er_2O_3を含有させていないNo.23～25のガラスに比べ、Hvが大きく向上した。

【0045】次に、No.1のガラス，No.5のガラス及び比較のため化学強化ガラス(No.12)の三点曲げ強度試験を行った。表3に三点曲げ強度の平均値(σ／MPa)示す。

【0046】

【表3】

表 3

No.	n	σ(MPa)
1	20	328
5	20	391
26	20	390

【0047】評価は、ガラス厚さ0.63mm，幅2mm，長さ3mm の試験片を用いて行った。下部スパンは1.2mm とした。試験片数（n）は各試料とも20とした。加えた荷重をwとすると、三点曲げ強度σ（MPa）は

$\sigma=(3lw/2at^2)$

となる。ここで、l；下部スパン，a；試験片の幅，t；試験片の厚さである。No.1のガラスの平均の三点曲げ強度は328MPaであった。Er_2O_3を10.0重量％含有したNo.5のガラスでは、平均の三点曲げ強度は391と、約19％強度が向上しており、化学強化ガラス（No.26）と同等の強度を有していた。

【0048】次に希土類酸化物を含有させることによる機械的強度向上のメカニズムを検討するため、透過型電子顕微鏡によりNo.1～8、及び10のガラスの微構造を観察した。

【0049】No.1及び10の希土類酸化物を含有しないガラスは均質な非晶質状態であった。一方、No.2～8のガラスでは、非晶質のガラスマトリックス中に、ナノオーダーの微細な粒子が析出していた。高分解能像の観察により、これらの微粒子は、結晶質であることが分かった。このように、希土類酸化物を含有したガラス中では、微粒子が観察され、機械的強度向上の度合いが大きかった。一方、No.10のガラスのように、Al_2O_3等を含有させたガラスでは、ガラス中に微粒子は観察されず、強度向上の度合いも小さかった。このことから、この微細粒子の存在により強度が向上したと考えられる。

【0050】この微結晶粒子の粒径は、Er_2O_3含有量

により異なっていた。各ガラスに生じていた微粒子の平均粒径及び白色光の透過率を表４に示す。

【００５１】

【表４】

表　4

No.	2	3	4	5	6	7	8
Er_2O_3含有量（重量比）	1.0	2.0	5.0	10.0	15.0	16.0	21.0
平均粒径(nm)	1	3	8	15	38	51	103
透過率(%)	91	85	79	74	70	67	58

【００５２】また、Er_2O_3添加量に対する析出している微結晶粒子の平均粒径と、ガラスの透過率の関係を、図３，図４に示す。平均粒径は、Er_2O_3添加量のほぼ２乗に比例して上昇していた。透過率は、Er_2O_3添加量の負に比例して減少した。光の透過率と光情報記録の効率を調べたところ、白色光の透過率が６０％以上では高効率で記録再生が行われたが、６０％未満では、高効率での記録再生は行えなかった。従って、白色光の透過率は６０％以上であることが好ましい。No.１６のガラスの平均粒径は５１ｎｍであり、ＴＥＭ写真より計算される粒子の体積率は２２％であった。これらのことから、平均粒径が５０ｎｍを超えると、粒子の体積率が増大し、白色光の透過率が減少する。このため、Er_2O_3含有量が１６重量％を超え、析出粒子の平均粒径が５０ｎｍを超え、さらに析出粒子の体積率が２０％を超えると、好ましくない。

【００５３】次に、No.１のガラスに、いろいろな希土類元素を含有させて検討を行った。表５に、添加した希土類元素の種類、及び得られたガラスのガラス転移温度(Tg)，熱膨張係数，マイクロビッカース硬度（Ｈｖ）を示す。図５，図６に、添加した希土類元素に対するＨｖとＴｇの関係を示す。添加は、Ln_2O_3の酸化物で行った。添加量は、各酸化物とも０.０２６mol％とした。ガラスの作製方法，特性の測定方法は、表１と同様である。

【００５４】

【表５】

表　5

No.	Ln	Ln_2O_3 含有量（重量比）	Tg（℃）	α	Hv
27	Sc	3.58	593	91.4	666
28	Y	5.89	582	81.6	653
29	La	8.47	583	90.2	650
30	Ce	8.53	582	91.3	648
31	Pr	8.61	585	92.2	651
32	Nd	8.78	587	86.4	646
33	Sm	9.07	584	93.5	651
34	Eu	9.19	585	95.5	652
35	Gd	9.46	580	90.9	685
36	Tb	9.51	583	90.3	682
37	Dy	9.70	581	90.6	683
38	Ho	9.82	584	91.6	682
39	Er	10.00	582	92.2	683
40	Tm	10.03	586	92.0	682
41	Yb	10.30	588	90.9	685
42	Lu	10.40	585	91.1	684

【００５５】マイクロビッカース硬度を見ると、いずれの希土類元素を添加した場合でも上昇していた。その上昇量を見ると、Gd_2O_3から重元素側の、いわゆる重希土類元素を添加した場合の方が大きかった。それらの硬度の値は６８０以上で、化学強化ガラスのＨｖよりも大きかった。一方、Sc_2O_3からEu_2O_3までの軽希土類元素を添加した場合では、６５０前後と、化学強化ガラスの水準よりも下回っていた。

【００５６】ガラス転移温度はどの元素の場合でも約５８５℃で一定であった。熱膨張係数は、８１.６〜９２.２×10^{-7}／℃の範囲であり、情報記録媒体層とのマッチングは良好であった。以上の検討より、添加する希土類元素の種類としては、Ｇｄ，Ｔｂ，Ｄｙ，Ｈｏ，Ｅｒ，Ｔｍ，Ｙｂ，Ｌｕが望ましい。

【0057】Gd_2O_3を含有したNo.21のガラスの構造をＴＥＭにより観察したところ、Er_2O_3を添加したガラスと同様の微結晶粒子が観察された。平均粒径は、15nmであった。

【0058】次に、母ガラスの組成の検討を行った。SiO_2の含有量が40重量％未満では、機械的強度，化学的安定性が損なわれるため、好ましくなかった。また、SiO_2含有量が80重量％を超えると、溶融性が低下し脈理が多く発生した。また熱膨張係数が小さくなりすぎ、基板用ガラスとしては不適切であった。以上から、SiO_2の含有量は40重量％～80重量％であることが好ましい。

【0059】本母ガラスにB_2O_3を含有させたところ、流動性に優れ、適正な熱膨張係数のガラスが得られた。しかしその含有量が20重量％を超えると、希土類含有による機械的強度向上の効果が小さくなった。このため、B_2O_3の含有量は20重量％以下であることが好ましい。

【0060】次にアルカリ金属酸化物の検討を行った。アルカリ金属酸化物（Li_2O，Na_2O，K_2O）の含有量の合計が20重量％を超えると、化学的安定性が低下した。このことから、アルカリ金属酸化物の含有量の合計は、0～20重量％であることが好ましい。さらに、アルカリ土類金属酸化物についても同様に、20重量％を超えると、化学的安定性が低下した。このことから、アルカリ土類金属酸化物の含有量の合計は、0～20重量％であることが好ましい。

【0061】アルカリ金属酸化物とアルカリ土類金属酸化物とB_2O_3は、ガラスを低融点化させる意味では同様の効果が見られたが、その合計量が10重量％未満では流動性が悪く、脈理が多く発生した。また30重量％を超えると、化学的安定性が低下した。このことから、アルカリ金属酸化物，アルカリ土類金属酸化物及びB_2O_3の含有量の合計は、10～30重量％であることが好ましい。

【0062】またAl_2O_3はガラスの機械的強度や化学的安定性を増加させるのに効果的であったが、その含有量が17重量％を超えると、ガラスの流動性が低下し、好ましくなかった。従って、Al_2O_3の含有量は、17重量％以下であることが好ましい。

【0063】また、希土類酸化物の含有量は、30重量％を超えるとガラス溶解時に原料粉がガラス中に残存するため、均一なガラスを得ることが難しく、好ましくなかった。アルカリ金属酸化物の含有量の合計が少ないほど少量の希土類酸化物の添加で機械的強度の向上の効果が得られた。アルカリ金属酸化物とアルカリ土類金属酸化物の合計量が10重量％のとき、希土類酸化物の添加量が0.5重量％でも機械的強度の向上が見られた。しかし、0.5 重量％未満では機械的強度向上の効果が小さかった。従って、希土類酸化物の含有量は0.5 ～30重量％であることが好ましい。

【0064】本発明のガラス基板は、希土類元素を添加したことにより、十分な強度を得ている。従って、従来のガラス基板で必要であった化学強化が不要とできる。すなわち、ガラス表面に残留応力を生じさせた圧縮強化層がないことを特徴としている。表面の圧縮強化層の有無は、例えばレーザ光線を表面から照射し、反射光をプリズムを用いて分光する方法により測定できる。本発明のガラス基板を上記方法で測定すると、ガラス基板内部と表面での残留応力差がほとんどない、すなわち表面応力層がないことが確認された。

【0065】次に、実施例のガラスを用いて実際の基板を作製して、その特性を評価した。ガラスにはNo.1，5，7，8，18，35のガラスを用いた。また、比較例としてNo.26の化学強化ガラス基板、及び表6に示す$SiO_2-Al_2O_3-ZnO-MgO-RO$系結晶化ガラス基板を評価した。

【0066】

【表6】

表 6

No.	Tg(℃)	α	Hv	備　考
43	780	114	720	結晶化ガラス

【0067】作製したガラス基板は、65mmφ，0.635mmt とした。得られた基板の耐水性，耐熱性，表面粗さ及び白色光の透過率を表7に示す。

【0068】

【表7】

表７

No.	耐　水　性 アルカリ濃度(ppm)	耐熱性	表面粗さ Ra(Å)	透過率 (%)
5	10.0	○	4	74.0
35	15.0	○	4	94.0
26	312.0	△	4	95.0
43	2.0	○	9	15.0
1	11.0	○	4	94.0
7	11.5	○	5	67.0
8	10.7	○	10	58.0
18	4.0	○	5	79.0

【００６９】耐水性は、７０℃の温純水８０ｍｌに基板を２０時間浸漬し、純粋中に溶出した全アルカリ，アルカリ土類元素量を検出し、トータルの溶出量をppm で表示した。耐熱性は、基板を真空中３５０℃に加熱し、その後、表面部を二次イオン質量分析した。表面層にアルカリイオンの拡散が見られたものは△、見られなかったものは○で表示した。表面粗さは表面粗さ計を用いて平均表面粗さＲａ（Å）で評価した。また、透過率は白色光源基板表面に照射し、入射光と透過光の強度比で求めた。

【００７０】耐水性をみると、No.１，５，７，８，１８，３５，４３では溶出アルカリ量が少なく、良好であった。No.２６の化学強化ガラスでは、アルカリの溶出量が多く、良好とはいえなかった。

【００７１】同様に耐熱性試験においても、No.２６の化学強化ガラス基板では表面層に多くのアルカリ元素が検出され、イオンの移動が起こっていることがわかった。以上のように、化学強化したガラス基板ではアルカリ元素の移動が生じやすく、不安定であったのに対し、本発明のガラス基板では、熱的，化学的な安定性が良好であった。

【００７２】次に表面粗さを見ると、No.１，７，１８，５，３５，２６のガラス基板では、Ｒａ＝４～５Åと、良好な平滑性が得られた。一方、No.８，４３のガラスでは、Ｒａ＝９～１０Åと、大きな値となった。

【００７３】白色光の透過率は、No.１，７，５，１８，３５，２６では６７～９５％と良好であった。No.８，４３のガラスでは透過率は５８，１５％と低かった。

【００７４】表面粗さと微粒子の析出状態の関係について調べた。No.７のガラスでは、Er_2O_3の含有量は１６重量％で、析出している微粒子の平均粒径は、５１ｎｍであった。また、粒子の体積率は４０％であった。この時、透過率は６７％であった。一方、No.８のガラスではEr_2O_3の含有量は２１重量％で、析出している微粒子の平均粒径は１０３ｎｍであり、粒子の体積率は７２％であった。また、透過率は５８％であった。このとき、No.７のガラスでは表面粗さが５.０Å,No.８のガラスでは１０.０Å と２倍表面が粗くなっていた。このように、Er_2O_3含有量が２０重量％を超え、また平均粒径が１００ｎｍを超え、透過率が６０％未満では、表面粗さが粗く、平滑性に劣ることがわかった。

【００７５】以上のことから、Er_2O_3等の希土類酸化物の含有量は２０重量％以下であることが好ましい。さらに平均粒径は１００ｎｍ以下であることが好ましい。また透過率は６０％以上であることが好ましい。以上の条件を満たせば、十分に小さい平滑性を得ることができる。

【００７６】上記８種類のガラス基板に磁性膜を形成し、磁気ディスクを作製し、特性を評価した。作製した磁気ディスクの膜構成を図８に示す。図８において、１はガラス基板、２はＣｒプリコート膜、３はＣｒ下地膜、４はＣｏＣｒ系磁性膜、５はＣ保護膜、６はエッチングテクスチャー、７は潤滑膜である。

【００７７】６５mmφの磁気ガラス基板を洗浄後、Ｃｒプリコート膜を２５ｎｍ，Ｃｒ下地膜を５０ｎｍ，ＣｏＣｒ系磁性膜を５０ｎｍ成膜した。カーボン保護膜を１０ｎｍ形成後、エッチングテクスチャーを施した。テープクリーニング後、潤滑膜７を塗布して磁気ディスクとした。なお、成膜は基板両面に施した。その後、磁気ディスクの磁性膜のアルカリによる侵食状況及び膜剥がれの有無を評価した。この磁気ディスクを用いて磁気ディスク装置を作製した。図１０に作製した磁気ディスク装置の概略図を示す。図１０において、８は図８に示した磁気ディスク、９は回転軸、１０はスピンドルモーター、１１は磁気ヘッド、１２は磁気ヘッド回転軸、１３は電気系の出力端子である。装置内には６枚の磁気ディスク８を回転軸９に装着した。磁気ヘッド１１をそれぞれの基板両面に２個配した。制御系等を接続し、磁気ディスク装置とした。磁気ディスク回転中のヘッド浮上量は４０ｎｍとした。

【００７８】本磁気ディスク装置を用いて記録再生特性

を評価した。アルカリ侵食状況，膜剥がれ，記録再生特性を表８に示す。

【００７９】

【表８】

表 8

No.	アルカリ侵食	膜剥がれ	記録再生特性
5	○	○	○
21	○	○	○
12	△	△	○
29	○	○	△

【００８０】アルカリ侵食状況は、得られた磁気ディスクのうち、侵食が見られた磁気ディスクの割合が５％未満の場合は○、５％以上の場合を△とした。膜剥がれも同様に評価した。記録再生特性は良好なものを○，良好でないものを△で表示した。本発明の磁気ディスクは、アルカリ侵食，膜剥がれが少なく、記録再生特性も良好であった。No.１２の化学強化ガラスでは、アルカリ侵食，膜剥がれが顕著に見られ、好ましくなかった。また、結晶化ガラスNo.２９では、アルカリ侵食，膜剥がれ等は見られなかったが、記録再生特性が良好でなかった。次に、本発明のいろいろなガラスを用いてガラス基板を作製し、耐衝撃性試験を行った。耐衝撃性試験は、ガラス基板の両面に前述と同様の工程によって磁性膜，保護膜等を形成し、図８に示す膜構造の磁気ディスクを作製し、このディスクを用いて評価した。試験方法は、作製したディスクを治具に固定し、加速器によってダミーヘッドをディスクに衝突させることによって行った。この試験を１種類の磁気ディスクに対して３０点行い、割れ，かけ等の不良の出た点の頻度で評価した。基板用ガラスには、表１のNo.１～５，１４，１８，２３，２

４，２５，２６，４３のガラスを用いた。図７に試験結果を示す。横軸は各ガラスのＨｖ、縦軸は本試験による不良頻度を％で表示した。ガラスの硬度が６７０を境界として、それ以下の硬度では不良が見られ、その量は硬度が低下するにつれて上昇していった。また、６７０以上では、本試験における不良は見られなかった。以上のことから、ガラス基板硬度が６７０以上であれば、耐衝撃性試験に耐え得る磁気ディスクを作製することができる。

【００８１】同様に光ディスク、及び光ディスク装置を作製した。本発明のガラス基板を用いたところ、記録媒体層の膜剥がれもほとんどなく、また高効率で記録再生することができた。

【００８２】以上のように、本発明の情報記録ディスクは、化学的安定性に優れ、膜剥がれ等の不良も少なかった。また情報記録ディスク装置の記録再生特性も良好であった。さらにガラス基板に化学強化処理や結晶化処理を施さないため、低コストにディスクや装置を作製することができた。

【００８３】（実施例２）本発明のガラス基板を用いて図９に示す形状の磁気ディスクを作製した。基板の厚さは、０.３８㎜とした。また、ガラスには化学強化処理をしていないNo.５のガラスを用いた。また、通常施されるプリコート膜を形成せず、ガラス基板上に直接磁性薄膜を形成した。ガラス基板の表面粗さはＲａ＝４.０Å であった。比較例としてアルカリ強化処理を施したソーダライムガラス，アルカリ強化処理を施していない通常のソーダライムガラス、及び結晶化ガラスを基板とした磁気ディスクも作製した。

【００８４】表９に強度，平滑性，磁性膜のアルカリ腐食，磁気特性についての評価結果を示す。特性が良好なものを○，良好とはいえないものを△で評価した。

【００８５】

【表９】

表 9

基 板	強度	平滑性	磁性膜のアルカリ腐食	磁気特性	備 考
No.５ガラス	○	○	○	○	実施例
化学強化ソーダライムガラス	○	○	△	△	比較例
化学強化なしソーダライムガラス	△	○	○	○	比較例
結晶化ガラス	○	△	○	△	比較例

【００８６】本発明の磁気ディスクでは、強度が高く、０.３８０㎜ の薄さでも十分な強度が得られた。また、平滑性も良好であった。磁性膜の腐食も見られず、プリコート膜を形成しなくとも磁性膜が劣化することはなかった。また、平滑性が良好なことから磁気ヘッドの浮上量も３０ｎｍ以下とすることができ、磁気特性も良好であった。

【００８７】化学強化処理したソーダライムガラスでは、高い機械的強度は得られたものの、プリコート膜がないためにガラスのアルカリ成分が磁性膜を侵食した結果、実機摺動試験後の磁気ヘッドの浮上面にアルカリ成分が付着しているものが多く見られた。また、摺動後に

磁性膜が剥離しているものも見られた。不良がみられなかった磁気ディスクにおいても、磁気特性が全体的に低下していた。化学強化していないソーダライムガラスを用いた磁気ディスクでは、強度が不十分であった。結晶化ガラスでは、表面粗さが大きく、平滑性が良好でないために、磁気ヘッドの浮上量が大きく、十分な磁気特性が得られなかった。

【００８８】

【発明の効果】本発明の第１の発明によれば、十分な機械的強度を有するため薄板化が可能で、かつ化学的安定性，均質性に優れるため中間膜を設ける必要のない情報記録用ディスクを提供することができる。

【００８９】本発明の第２の発明によれば、体積あたりの磁気ディスクの枚数を多くすることができるので、同じ記録密度であれば、小型，軽量な磁気ディスク装置が提供できる。また、磁気記録媒体が、中間膜の構造，組成に影響されて、磁気的特性を低下させることがなくなる。

【００９０】本発明の第３の発明によれば、ディスクの製造誤差の許容幅を広げることが可能になる。

【００９１】本発明の第４の発明によれば、製造時の取扱い、例えばガラス鋳造後の表面研磨の際にある程度研磨速度を大きくしても、表面に割れが発生しない、製造後の基板運搬のハンドリングが容易になる等により、歩留り向上が図れ、製造コストの低減が図れる。

【００９２】本発明の第５の発明によれば、製造コストが小さいため、安価に大容量の情報記録ディスク装置が提供される。

【図面の簡単な説明】

【図１】Er_2O_3，Al_2O_3，Si_2O_4添加量に対するマイクロビッカース硬度の変化。

【図２】Er_2O_3，Al_2O_3，Si_2O_4添加量に対する熱膨張係数の変化。

【図３】Er_2O_3添加量に対する析出した微結晶粒子の平均粒径の変化。

【図４】Er_2O_3添加量に対する白色光の透過率の変化。

【図５】各希土類酸化物を添加したときのマイクロビッカース硬度の変化。

【図６】各希土類酸化物を添加したときのガラス転移温度の変化。

【図７】基板硬度（Ｈｖ）と不良率の関係。

【図８】本発明で作製した磁気ディスク基板の膜構成図。

【図９】本発明の別の実施例で作製した磁気ディスク基板の膜構成図。

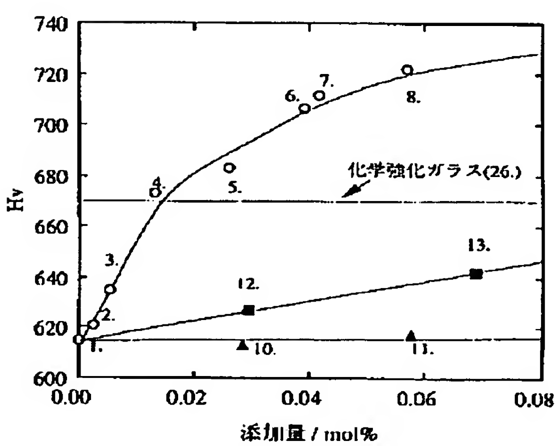
【図１０】本発明で作製した磁気ディスク装置の概略図。

【符号の説明】

１…ガラス基板、２…プリコート膜、３…下地膜、４…磁性膜、５…保護膜、６…エッチングテクスチャー、７…潤滑膜、８…磁気ディスク、９…回転軸、１０…スピンドルモーター、１１…磁気ヘッド、１２…磁気ヘッド回転軸、１３…電気系の出力端子。

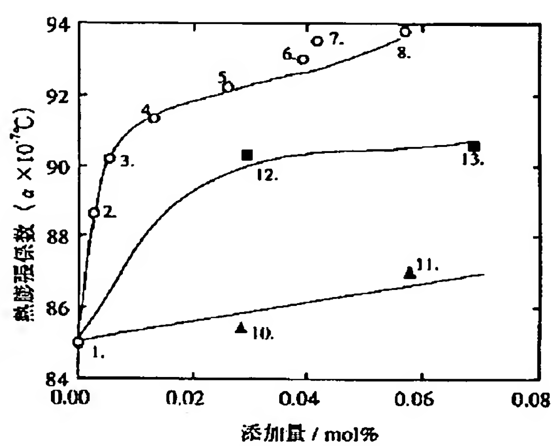
【図１】

図 1



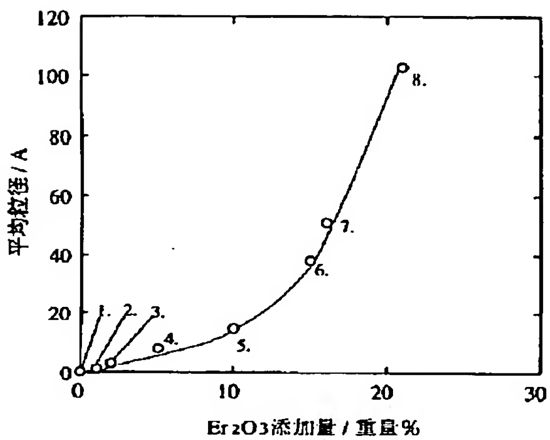
【図２】

図 2



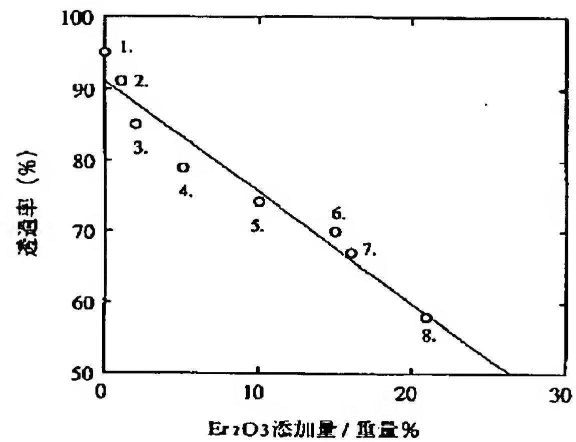
【図３】

図 3



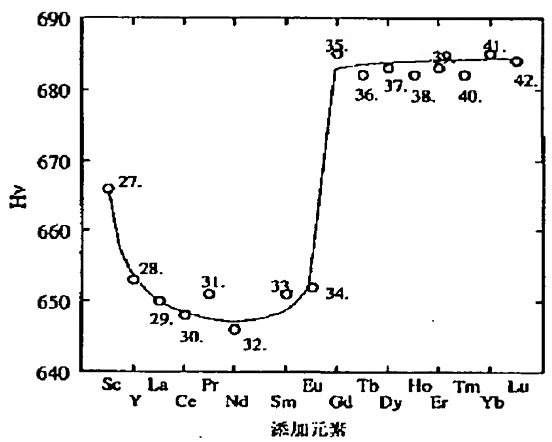
【図４】

図 4



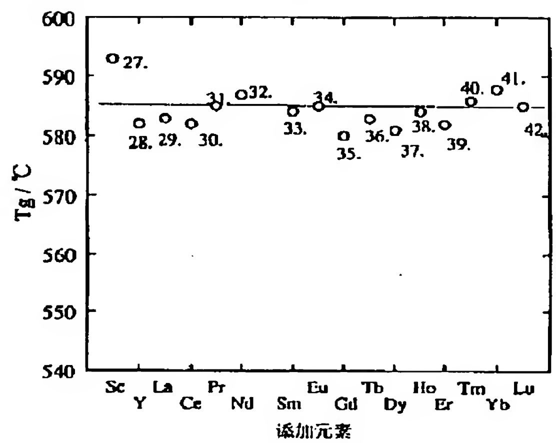
【図５】

図 5



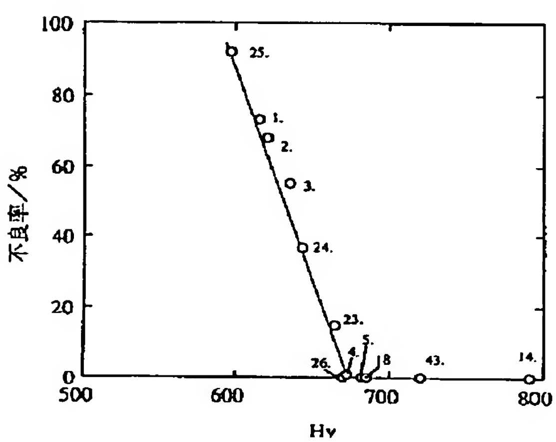
【図６】

図 6



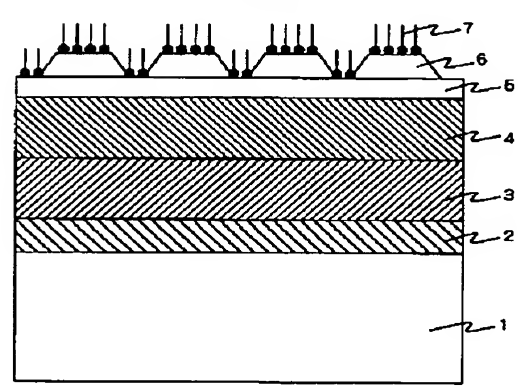
【図７】

図 7



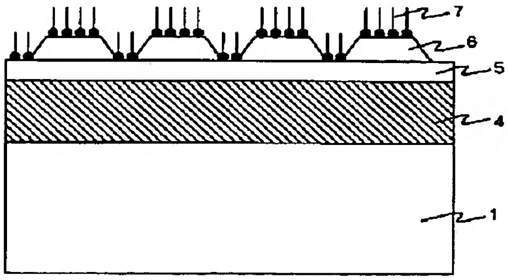
【図８】

図 8



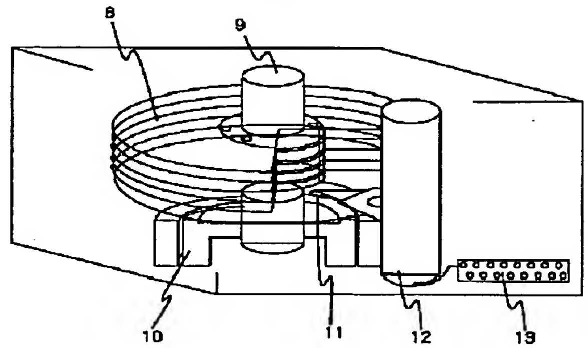
【図９】

図 9



【図１０】

図 10



フロントページの続き

(72)発明者　高橋　研
茨城県日立市大みか町七丁目１番１号　株式会社日立製作所日立研究所内

(72)発明者　渡辺　正博
神奈川県小田原市国府津２８８０番地　株式会社日立製作所ストレージシステム事業部内

(72)発明者　武尾　典幸
神奈川県小田原市国府津２８８０番地　株式会社日立製作所ストレージシステム事業部内